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OF

THE COMMISSIONERS

UPON THE SUBJECT OF

HARBOURS OF REFUGE.

LONDON:

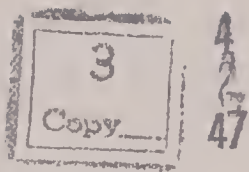
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*Copy of Treasury Minute, dated 2nd April, 1844.*

SIR ROBERT PEEL states to the Board, that the attention of Her Majesty's Government has been directed to the recommendation of the Select Committee of the House of Commons on Shipwrecks, which sat last year, relative to the formation of Harbours of Refuge.

The Committee stated that they refrained from recommending any particular situations for such harbours, from a conviction that such points would be best decided on by a body composed of scientific and competent persons, whose attention should be specially and exclusively directed to the subject.

For the purpose of enabling Her Majesty's Government to form a final and satisfactory judgment on this important subject, Sir Robert Peel recommends to the Board, that the undermentioned gentlemen, who have already signified to him their readiness to undertake the duty, should be appointed Commissioners to inquire into the most eligible situations for choosing a Harbour or Harbours of Refuge in the Channel :—

Admiral Sir Byam Martin, G.C.B., Chairman.  
 Lieut.-General Sir Howard Douglas, Bart., G.C.B.  
 Rear-Admiral Deans Dundas, C.B.  
 Captain Sir William Symonds, R.N.  
 Captain John Washington, R.N.  
 Lieut.-Colonel Colquhoun, R.A.  
 Lieut.-Colonel Alderson, R.E.  
 Sir J. H. Pelly, Bart.  
 Captain Fisher, R.N.  
 James Walker, Esq., President of the Institution of Civil Engineers.

My Lords entirely concur with Sir Robert Peel, and desire that these gentlemen may be appointed accordingly.

The more immediate points for the consideration of the Commissioners appear to be the following :—

1st. Whether it be desirable that a Harbour of Refuge should be constructed in the Channel, reference being had, on the one hand, to the public advantages likely to result from the construction of such a work, and, on the other, to the expense to be incurred in its completion.

2ndly. What site would be the most eligible for such a harbour, on account of its combining in the greatest degree the following grounds of preference :—

1st. That it should be of easy access at all times of the tide to vessels requiring shelter from stress of weather.

2ndly. That it should be calculated for a station for armed vessels of war in the event of hostilities, both for the purposes of offence and defence ; and,

3rdly. That it should possess facilities for ensuring its defence in the event of an attack by the enemy.

In case the Commissioners should consider that all these objects will not be accomplished by a single Harbour of Refuge in the Channel, they are authorized to extend their inquiries accordingly, and to report their opinion of the peculiar



advantages which the several situations which they may recommend would respectively possess, and to which of them, on the whole, they would give the preference.

My Lords will transmit to the Commissioners the several Reports which contain the result of previous investigations into this subject; and they doubt not that the Commissioners will fully consider the bearing of the evidence which has been already adduced, and will call for such further evidence as it appears to them desirable to obtain before forming their final judgment upon this important subject.

My Lords will be prepared to defray any expenses which may be necessarily incurred by the Commissioners in prosecuting their inquiries, upon the accounts being forwarded to this office; an adequate remuneration being included for a Secretary, in case the Commissioners should deem the assistance of a Secretary requisite; in which case the appointment of a Secretary would be left to the Commissioners.

My Lords will also take care that rooms shall be provided for the Commissioners when they may meet in London.

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## R E P O R T.

### TO THE RIGHT HONOURABLE THE LORDS COMMISSIONERS OF HER MAJESTY'S TREASURY.

REPORT.

WE, the undersigned Harbour Commissioners, appointed by your Lordships' Minute, of the 2nd of April last, whose names are hereunto subscribed, have the honour to report to your Lordships the result of our proceedings in pursuance of the objects pointed out to us in that Minute. Preliminary Remarks.

We entered upon our important and difficult duties with a deep sense of the responsibility under which we should have to offer our opinions.

This feeling lost nothing of its force during our visit to the south-east coast, nor is it diminished on a review of the circumstances under which we have now to present for your Lordships' consideration, proposals, which if approved, must necessarily trespass largely on the public revenue.

The Treasury Minute, under which we act, gives, for our guidance, three principal objects, viz. Treasury Minute.

First. The formation of Ports of Refuge for the safety and convenience of vessels navigating the British channel.

Secondly. That these should be calculated to become, in the event of hostilities, the stations for ships of war.

Thirdly. The consideration of expense as compared with the public advantages likely to result from the construction of such works.

Our instructions do not bind us by any strictly specific limits. We are told, "If we think one harbour in the channel is not sufficient, we are at liberty to extend our inquiries accordingly." No specific limits

We availed ourselves of the scope thus given to us, and being unanimously of opinion that one harbour would not be sufficient, we proceeded to the extreme west of the narrow part of the channel at Portland; and eastward to Harwich, which, though not strictly within the limits of the channel, is on the south-east coast, and forms an important termination to our line in that direction. Any less comprehensive view of the coast would have fallen short of the spirit of your Lordships' instructions.

The surveyors placed at our disposal by the Admiralty, were directed to make detailed surveys of the anchoring ground at each place, and also to ascertain if any change had occurred since the publication of the last charts.

This service has been admirably performed by Captain Washington and the officers of Her Majesty's surveying vessel the *Blazer*, at the eastern ports, and at Portland, with equal skill, by Commander Sheringham and the officers of the *Fearless* surveying vessel. Requisite Surveys made.

Throughout our proceedings we have received unlimited assistance from the Lords Commissioners of the Admiralty, and, amongst other advantages, their Lordships have permitted us to refer, as occasion required, to their hydrographer, Captain Beaufort, whose ready help has been most useful. Assistance from Admiralty, &c.

We obtained every information we could desire from the officers of the Cinque Ports, from the officers of the Royal Engineers, the collectors of customs, and from the officers of the Coast Guard.

The Report of the "Select Committee of the House of Commons on Shipwrecks" to which we are referred by your Lordships, has been read by each member of the Commission, and the copious information contained in that volume is well worthy the attention of all who may at any time be engaged in considering matters relating to the ports and maritime interests of the kingdom.

It was not to be supposed that an inquiry of such a nature as the construction of harbours could be entered on without bringing forward many intelligent Plans and Proposals examined.



## REPORT.

persons with propositions of various kinds; and the Appendix shows their names, and the nature of their proposals.

To each individual we have given a patient hearing, as our Minutes of Examination fully testify; and every fair consideration has been bestowed on their plans.

Evidence of Shipping Interest.

We invited the Chairman of Lloyds and the Chairman of the Ship Owner's Society to meet us, or to delegate others, to state the opinions of those great mercantile bodies, with reference to the positions they consider best as ports for the shelter of the trade.

Evidence at the different Ports.

We have also had before us every class of persons who were thought capable of affording information, including several eminent engineers; and, in order to guard against the often misleading opinions of residents at the different ports, we have examined many others, practically acquainted with the various places, whom we believed to be unbiassed by local partialities.

The examination of persons so varied in their pursuits could not but afford much useful information; it has however been no light task to deal with the conflicting opinions they offer.

With these preliminary remarks, we proceed to lay before your Lordships the result of our deliberate consideration of the whole of the circumstances which have earnestly occupied our attention.

## FORENESS.

Foreness near Margate.

We proceeded, in the first instance, to Foreness, near the North Foreland, the site which the Harbour Commission of 1840 recommended as the place third in importance for an artificial harbour, giving a preference, first to Dover, and secondly to Beachy Head.

It is right to name the persons who composed that Commission,\* in order that their opinions may have the influence justly due to the high distinction they hold in their different professions.

Commission of 1840.

The Commission of 1840 had specific limits assigned to its operations; namely, "To visit the coast between the mouth of the Thames and Selsea Bill; "to examine the ports with reference to their being available as places of shelter "for vessels passing through the Channel in cases of distress from weather, and "also as places of refuge for merchant vessels from enemies' cruizers, in time of "war; and more especially as to their being made stations for armed steamers "employed for the protection of our trade in the narrow parts of the Channel."

We quote this instruction both with reference to what we have to state respecting Foreness, and to other matters we shall have to mention in the course of our Report.

Position of Foreness.

Foreness stands well in the fairway of the traffic between the Thames and the Downs, and would, no doubt, if converted into a harbour, frequently prove to be a very convenient anchorage for outward-bound vessels, caught off the Foreland by strong south-west gales, and for homeward-bound ships meeting with adverse winds.

The Commission of 1840 give weight to their proposal in favour of Foreness by observing that a harbour there "must be regarded as one of refuge for vessels "navigating or stationed in the North Sea;" but, if their instructions had not precluded them from the consideration of Harwich, we think they would have suggested the improvement of that splendid natural harbour at a small expense, rather than have proposed a large outlay of money in constructing one at Foreness.

Superior position of Harwich.

Nothing can be more manifest than the fact that Harwich, as far as position goes (being actually on the shores of the North Sea), is the proper place for a squadron of steamers on that station, as well as for a Harbour of Refuge for merchant ships; while the neighbouring anchorage in Hollesley Bay is favourably suited for ships of the line.

Foreness not recommended.

On this account it seems to us unnecessary to construct a harbour at Foreness; and we think the Commission of 1840 would have taken the same view of the subject if Harwich had come within their examination.

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\* Rear-Admiral Sir James Gordon, K.C.B.; Captain Vidal, Admiralty Surveyor, now commanding Her Majesty's surveying vessel the Styx; Lieut.-Colonel Thompson, Royal Engineers; Captain Drew, an elder brother of the corporation of the Trinity House; James Walker, Esq., and William Cubitt, Esq., civil engineers.



RAMSGATE.

Our next visit was to the port of Ramsgate, a mere creek in 1748, but now of such capacity that, in the last three years, the number of vessels which arrived in that harbour amounted on an average to 1600 sail a-year, exclusive of fishing craft, town hoys, and the daily voyages of steamers.

Utility of Ramsgate Harbour.

Ramsgate Harbour is kept clear partly by its back-water; and, if ever the basin at the west end, designed by the late Mr. Rennie, be carried into execution, it will give increased power of backwater, and enable the port to receive many more ships.

The improvement of Ramsgate Harbour is the result of vigorous efforts by the managing trustees; and their success, which cannot be too highly appreciated, is forcibly exhibited by contrasting its present increased utility with the facts stated by the celebrated Smeaton, who says that the number of vessels that entered the harbour in the year—

Improvement of the Harbour.

“ 1780 amounted to . . . . .	29	} sail.”
1785 „ . . . . .	215	
1790 „ . . . . .	387	

whereas, in the three last years, it appears on the evidence of the harbour master, there arrived in the port, in—

1841 . . . . .	1543	} Average, 1600 sail.
1842 . . . . .	1652	
1843 . . . . .	1606	

Of the number of vessels that arrived in 1843, 31 gave an average of 457 tons each; and when it is recollected that more than two-thirds of the trade of Great Britain is carried on in vessels under 400 tons, it shews the advantage the mercantile marine derives from this port in connection with the Downs.

Great increase Trade.

The harbour-master states that, in the winter of 1832, there were, at one time, 434 sail in the port; and if the additional basin before alluded to at the west end be made, there will be room for upwards of 600 sail.

It will be an improvement if the approaches and entrance to the harbour can be deepened by the use of dredging vessels, or other means applicable to the purpose.

Approaches should be deepened.

THE BRAKE, OR SMALL DOWNS.

The next place we have to notice is “The Brake,” within which is the anchorage called the “Small Downs.”

Situation.

It is here that a harbour has been proposed by Sir John Henry Pelly, Deputy Master of the Corporation of the Trinity House, one of the Committee of Management of Ramsgate Harbour, and a member of this Commission.

Any suggestion of this nature, coming from such a quarter, could not fail to engage our best attention.

The “Small Downs” is an anchorage of considerable extent, lying between the Brake Sand and the shore, northward of Deal. The holding-ground is good, and it is the general anchorage of the smaller class of merchant vessels having occasion to bring up in the Downs, thus leaving the Great Downs more clear for ships of larger draught of water.

Small Downs.

The Brake Sand is about five miles in length, with a depth upon it at low water, spring tides, of from 3 to 12 feet. It shelters the Small Downs from the east, in the same way that the Goodwin Sand shelters the whole of the Downs for a distance of nine miles.

We have had before us an elaborate plan, and a very full report addressed to the trustees of Ramsgate Harbour respecting a design, prepared by Sir John Rennie, by which it appears that the breakwater he proposes to construct is to be five miles in length, at an estimated cost of 3,280,000*l*.

Proposal of Sir John Rennie.

This plan is to convert the Small Downs into a close harbour by constructing a solid work along the spine of the Brake, to be brought up two feet above the high-water mark.



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There is, however, a modified suggestion of Sir John Rennie, which if adopted, would reduce the cost to about 1,300,000*l*.

Proposal of Captain Vetch. See Appendix.

Another proposition was submitted to us for a work on the Brake Sand, by Captain Vetch, late of the Royal Engineers, by which he proposes to make a sheltered anchorage within the Brake at a cost of 850,000*l*.

Proposal of Sir S. Brown.

A third by Captain Sir Samuel Brown, R.N., also for the Brake, the details of which will be found in the Evidence.

Shifting of the Brake Sand.

It has lately been shown by an Admiralty Surveyor, Captain Bullock, that the Brake Sand has gone about 700 yards bodily in shore.

The Trinity House, on obtaining the survey from the Admiralty, shifted the south and middle Brake Buoys, and issued a printed notice to all mariners of this remarkable change.

Opinion of Commission of 1840.

The Commission of 1840, which included the late Captain Drew, one of the most able men of the Trinity House, say, in reference to the “expediency of enclosing the Small Downs,” that “the magnitude and extent of such a work, which would require a breakwater and pier of upwards of five miles in length, the small depth of water at the northern entrance, and the uncertain nature of the foundation, induce us to abandon the idea of a Harbour of Refuge at that place.”

According to the spirit of your Lordships’ instructions, and strictly in conformity with those issued by the Admiralty to the former Commission, we have in preference directed our attention to the narrow part of the Channel where the navigation is dangerous to ships contending with adverse winds, and where in war the risk of capture would be greatest; it is there that we are to provide harbours of refuge for merchant ships, and suitable ports to enable our vessels of war to maintain their stations in order to give protection to the passing trade.

A harbour in the Downs can only be for ships that have actually passed all the risks of the narrow part of the Channel, or for ships waiting to commence their voyage.

Not authorized to recommend it.

For these reasons, and considering the Downs in its present state an excellent roadstead, with Ramsgate Harbour immediately adjoining, capable of containing at one time upwards of 400 sail, and which may be made to receive 200 sail more, we do not feel ourselves warranted in proposing any outlay of the public money in the Downs.

## DOVER.

Importance of Dover in history.

History affords proof of the importance attached to this place as a military and naval station.

As the advanced post of England on the south-east coast, the want of a harbour here of sufficient capacity for the reception of vessels of war, and for the convenience and protection of trade, has attracted the notice of sovereigns and ministers from the earliest times, and has led to a large expenditure of money for the improvement of the present tidal harbour.

In considering positions eligible for the construction of breakwaters, it should be borne in mind that an inner harbour is an indispensable requisite, and if there is no natural advantage of that sort in the position selected, there must be the double operation of building an inner as well as an outer harbour.

Advantages of inside Harbour.

There are few places that in this respect possess greater advantages than Dover. It has a dry dock for repairs, and extensive quays, with storehouses. Besides the outer receiving harbour, there is a basin covering more than six acres (now being enlarged to double that size), and a third called the Pent, which the late Mr. Rennie, in his Report to Mr. Pitt, in 1802, says, may of itself be made capable of receiving many sloop-of-war and gun-brigs, and which the Dover Commissioners are now considerably improving.

Mr. Pitt desirous of a Breakwater at Dover.

Mr. Pitt, when Lord Warden of the Cinque Ports, was earnestly intent on having Dover Bay enclosed, and it was this circumstance which led to our obtaining from the Master-General of the Ordnance the plan of a harbour in Dover Bay, by the late Major-General Ford, of the Royal Engineers.

General Ford’s Plan.

Objections to Dover stated.

There are two points, each of great importance, which have been suggested as objections to any proposal for converting Dover Bay into a harbour; one that the holding ground is not good, the other that it will have a tendency to silt up.

Proof of good holding round in Dover Bay.

With respect to the quality of the anchoring ground, Her Majesty’s steam-vessel, the *Blazer*, of 500 tons and 120-horse power, was ordered there to test its tenacity to the utmost. The nature of the experiments and the satisfactory result will be seen in Captain Washington’s Report in the Appendix.



In reference to the question of silting up, the Commission directed samples of the water in Dover Bay to be taken up at different times of tide, in different depths, and under varying circumstances of weather, which have been transmitted to the Director of the Museum of Economic Geology for examination; the results, as reported by Mr. Phillips, will be found in the Appendix.

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Examination of Dover Bay water.

The Commission is of opinion that more extensive experiments are necessary in order to determine the quantities of matter borne in suspension by the tidal currents on this part of the coast and liable to deposit, and beg therefore to suggest to your Lordships the propriety of their being continued, under the direction of the Admiralty, for the space of a year, in all circumstances of weather.

More experiments recommended.

Dover, situated at a distance of only four miles and a half from the Goodwin Sands, and standing out favourably to protect the navigation of the narrow seas, is naturally the situation for a squadron of ships of war. Its value in a military point of view is undoubted; but the construction of a Harbour of Refuge there, is, in our opinion, indispensable, to give to Dover that efficiency as a naval station which is necessary in order to provide for the security of this part of the coast, and the protection of trade.

Dover favourably situated.

## DUNGENESS.

This place is a singular formation of shingle, spreading over a space of several miles, stretching out seaward into the fair way of the channel, and having at its termination deep water close to the beach. It is without buildings except the lighthouse and several batteries, the barracks of which are occupied by the Coast Guard.

Position of Dungeness.

The point of Dungeness has lengthened out considerably since the present lighthouse was built in 1792. There is an inscription within the tower, by which it appears that, at the time it was built, the sea was at a distance of 100 yards at low water. We, on our visit to that place, measured it, and found it to be about 190 yards, showing that it has lengthened out 90 yards in 52 years.

Increase of point.

It is to be regretted that no periodical account has been kept of the lengthening out of the point, which, if it had been taken every year, and registered in the lighthouse, would have afforded information of great importance, and would have shewn whether the rate of elongation has been uniform or otherwise. The Commission consider it very desirable that an accurate record be preserved hereafter of all alterations of Dungeness Point and its immediate vicinity, of its annual extension seaward, of the effect of great storms upon it, and generally of the movement of the shingle. For this purpose the Commission beg to suggest that the Admiralty, in conjunction with the Trinity House, be requested to give directions on the subject.

Should be measured periodically.

Dungeness has ever been remarkable for its good holding-ground. Both Bays afford excellent and extensive anchorage, according to the state of the wind. It is in evidence that upwards of 300 sail have been well sheltered in the East Bay at one time, and that more than 100 vessels were at anchor in the West Bay a few days before the Commission arrived there. Where nature presents so much accommodation and shelter, it will always be a matter for serious consideration whether it may not be well to be satisfied with what is already so good, and to give to other places of acknowledged importance in point of position, the artificial assistance they need, in order to render them available as places of secure anchorage. Dungeness does not possess the advantage of an inner harbour, as Dover, Seaford, and Portland; this, however, takes nothing from its value as a roadstead for merchantmen and for ships of war.

Good holding ground.

Has no harbour.

Having come to the conclusion that it is not expedient to construct a breakwater at Dungeness, we do not advert in detail to what has appeared in evidence as to the effects which such a work would be likely to produce on the lengthening or otherwise, of the point; and on the anchorage in the East and West Bays; but we refer to the opinions of several eminent civil engineers touching the advantages of this important place.

## BEACHY HEAD, EAST BOURNE, AND SEAFORD.

We have now to draw your Lordships' attention to the bay on the east side of Beachy Head, and westward of Langley point, which the Commission of 1840 proposed as a site for a breakwater.

East Bourne Bay



## REPORT.

Recent survey.

The shoals called the Royal Sovereign, and others, as laid down in the Admiralty Chart, first attracted our notice with reference to this work; it was, therefore, thought desirable to have a more detailed and extended examination of the bay by the surveying vessel placed at our disposal by the Admiralty.

Much shoal water.

The result has been the discovery of several other patches of shoal water, as shown in the accompanying chart, and our previous impression as to the hazard of placing a harbour of refuge in such a situation, has been so strengthened that we decided to look for a more eligible one on the west side of the Head. There is no inner harbour or opening along the coast on the east side of Beachy Head.

Seaford Road.

On the west side of Beachy Head the anchorage is free from the dangers which render the east side less eligible as a place for constructing a harbour of refuge. The holding ground off Seaford is of the best quality, and is much resorted to in easterly gales.

The Commission is of opinion that there is no good position in the neighbourhood of Beachy Head, where a harbour is as necessary as in any part of the Channel, (being about half way between Dover and Portsmouth,) except in Seaford Road, and the accompanying chart shows the place where a breakwater may be constructed with great advantage to the trade, and as a station for armed vessels.

The Commission are fully aware of the objections which may be made to the formation of a breakwater harbour on the west side of Beachy Head, considering the prevalence of the westerly wind; but the local disadvantages on the east side of the Head, induce them to give a decided preference to the west side, and the proximity of Newhaven has materially influenced their decision.

## NEWHAVEN.

Newhaven a convenient tidal harbour.

Newhaven is a convenient tidal harbour, and may be considerably improved inwardly, as well as by carrying out a breakwater from “Barrow Head” into a depth of three fathoms at low-water spring-tides; by advancing the piers seaward, giving a wider entrance, and dredging the channel enclosed between them; but as it cannot be made accessible at all times of tide, it does not come within the scope of our instructions to recommend any present outlay of the public money for this purpose.

May be improved.

It will be the interest of the Commissioners of the Upper and Lower Ouse to apply their revenues to the utmost advantage, so as to give increased facilities of access to the harbour should a breakwater be constructed in its vicinity.

## PORTLAND AND WEYMOUTH.

Position of Portland.

Our next and last visit westward was to Portland, which, from its situation with reference to the Channel Islands, and as the boundary of the narrow part of the Channel in this direction, came naturally within the range of our investigation.

A squadron stationed at Portland will have under its protection, jointly with Dartmouth, all the intervening coast, and these places, with Plymouth, will complete the chain of communication and co-operation between Dover and Falmouth, a distance of 300 miles.

There is everything at Portland to render the construction of a breakwater easy, cheap, and expeditious, and the holding-ground in the road is particularly good. A large part of the island facing the bay is Crown property, and contains abundance of stone. It has numerous springs, and plenty of the best water may be led in any direction for the supply of ships.

The roadstead also possesses the advantage of an inner harbour at Weymouth.

## HARWICH HARBOUR.

Harwich Harbour.

We have now to submit to your Lordships a few observations respecting Harwich Harbour, which we consider one of very great importance to the trade of the country.

This harbour, formed by the junction of the rivers Stour and Orwell, is



one of the finest, and may be rendered one of the most useful havens in the kingdom. It has a sufficient depth of water and good holding-ground over an extent capable of containing many hundred ships.

But with the exception of a channel, of 18 feet in depth, too narrow for general purposes, the entrance to this port is not deep enough to admit ships of more than 12 feet draught of water at low-water spring tides; it is therefore at present a tidal harbour as regards ships of a larger class.

It is remarkably well situated for the convenience of a North Sea squadron, and for the protection of the mouth of the Thames. Convenient position.

It is the only safe harbour along this coast, and is in the direct line of traffic between the Thames and the northern ports of the kingdom, as well as of the trade from the north of Europe.

There is a dock-yard with building slips belonging to the Crown, and the property under the Ordnance department is extensive.

It appears in evidence that by the falling away of Beacon Cliff, on the west side of the entrance, and the lengthening out of Landguard Point on the east side, the harbour has sustained great damage within the last 25 years. Deterioration from neglect.

The bottom at the entrance to the harbour, and the coast on each side, is composed of blue or London clay, in which are layers of "cement stone," in great demand both in England and on the Continent. Hundreds of hands are constantly engaged in collecting it, and the evidence shows that by excavating the cement stone in front of the Ordnance premises, near the foot of Beacon Cliff, the water has spread so as to be diverted from its natural course, and the tide rendered so comparatively feeble, that it no longer acts with its accustomed force on Landguard Point, which has consequently grown out 500 yards during the past 40 years, as shown by the plan. It has already nearly filled up the deep-water channel, and, by its further increase, threatens to destroy the entrance. Cement stone.

In the Appendix there are Reports to the Admiralty from the officer carrying on the surveying service in the neighbourhood of Harwich, to which we beg to refer for a full confirmation of our opinion of the necessity of taking immediate measures for the preservation and improvement of this harbour. If this be not done soon, it is impossible to calculate on the extent of mischief which may take place, for in every south-west gale the Beacon Cliff is in peril of being washed into the sea. Admiralty Reports Appendix.

We therefore feel it to be our duty to submit to your Lordships the pressing necessity for carrying out a breakwater, or stone groyne, from the outside of the Beacon Cliff, so as to surround the foot of it, and to extend the same over the shoal-water, to the north part of the Cliff-foot rocks, as described in the plan (No. 6). Breakwater recommended.

We also recommend deepening the channel to the harbour to 18 feet at low-water spring tides by removing the shoals called the "Altars," and the eastern part of another shoal called the "Glutton." Dredging recommended.

## PROPOSED BREAKWATERS.

Having made such observations respecting the different ports as may be necessary to enable your Lordships to form a judgment on the proposals we have to submit, and having given to the subject referred to us all the attention which its importance demands, we recommend:—

FIRST, that a harbour be constructed in Dover Bay according to plan No. 1, with an area of 520 acres up to low-water mark, or 380 acres without the two fathom edge; with an entrance 700 feet wide on the south front, and another of 150 feet at the east end. Dover Bay recommended.

Entertaining the strong opinion we have expressed of the necessity of providing without delay a sheltered anchorage in Dover Bay, we venture to urge upon your Lordships' attention the advantage of immediately beginning the work by carrying out that portion which is to commence at Cheesman's Head.

Whatever may be finally decided upon as to the form and extent of the works in Dover Bay, the pier from Cheesman's Head, run out into seven fathoms water, appears to be indispensable as a commencement, and it will afford both facility and shelter to the works to be subsequently carried on for their completion.

This will give sheltered access to the present harbour during south-west



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gales, and protect it from the entrance of shingle from the westward : it will afford time also for observation on the movement of the shingle within the bay, and for further inquiry as to the tendency which harbours of large area on this part of the coast may have to silt up.

These inquiries the Commission consider to be of essential importance, and the results will afford the means of determining on the greater or less width that should be given to the entrances of the proposed harbour.

Seaford Road recommended.

SECONDLY, we propose that a breakwater be constructed in Seaford Road in a depth of about seven fathoms water, one mile in extent, and sheltering an area of 300 acres, as shown in plan No. 2.

Portland Bay recommended.

THIRDLY, that a breakwater be constructed in Portland Bay, to extend a mile and a-quarter in a north-east direction, from near the northern point of the island, in about seven fathoms water, having an opening of 150 feet at a quarter of a mile from the shore, and sheltering an area of nearly 1200 acres, as shown in plan No. 3.

If only one work is to be undertaken at a time, we give the preference to Dover ; next to Portland ; and, thirdly, Seaford.

## MODE OF CONSTRUCTION.

Mode of construction.

Various plans for constructing breakwaters have been laid before us by highly intelligent individuals, whose projects are noted in the Appendix, and fully explained in the evidence.

We are directed by your Lordships to report on the expense to be incurred by the completion of the works we may recommend ; but as no approximate estimate of this can be made without determining the general principles and modes of construction, we have examined the engineers who have come before us, and other authorities, upon those important points.

Walls of masonry.

Their various opinions have been considered by the Commission, who prefer, for the construction of breakwaters, and for the security of the works of defence upon them, the erection of walls of masonry.

The Commission do not offer any opinion as to the profile or degree of slope necessary to ensure to the structure the requisite stability. They consider that this will be best decided by the Government, under professional advice, when the works shall be finally determined on.

Estimate of cost.

The cost of either mode of construction having been stated to be nearly the same, whether it be masonry, or a long slope of rough stone similar to that of Plymouth Breakwater, the Commission beg to lay before your Lordships an approximate estimate of the works at the several places, viz. :—

	£.
Dover . . . .	2,500,000
Seaford . . . .	1,250,000
Portland . . . .	500,000
Harwich . . . .	50,000

## MILITARY DEFENCES.

The military members of the Commission are of opinion that there will be no difficulty in providing for the defence of the proposed harbours.

Military defences.

They recommend that casemated batteries be constructed on the breakwaters themselves, and that these should be supported by works and defences on the shore, flanking the approach to them and to the entrances of the harbours.

At Dover and Seaford there already exist works of defence contiguous to the site of the proposed breakwaters capable of being adapted to this object.

The island of Portland possesses great natural advantages for defence, and for the formation of a naval and military depôt during war to any extent that may be required.

The military officers are further of opinion that the position and construction of the works necessary for the defence of the proposed harbours cannot be decided on until the exact site and relation of the latter to the shore shall have been finally determined.



## CONCLUSION.

The Commission cannot close their Report without expressing, in the strongest terms, their unanimous opinion and entire conviction that measures are indispensably necessary to give to the south-eastern frontier of the kingdom means and facilities, which it does not now possess, for powerful naval protection. Conclusion.

Without any except tidal harbours along the whole coast between Portsmouth and the Thames, and none accessible to large steamers, there is now, when steam points to such great changes in maritime affairs, an imperative necessity for supplying, by artificial means, the want of harbours throughout the narrow part of the Channel.

The distance chart which accompanies this Report shews the positions where, if our recommendations are carried out, harbours of refuge, or well-protected roadsteads, will afford shelter to our commerce. By these means, and with the advantages of steam by sea, and of railroads and telegraphic communication by land, the naval and military force of the country may be thrown in great strength upon any point of the coast in a few hours. Distance chart.

The several recommendations we have thought it our duty to lay before your Lordships must, if adopted, occasion a large outlay of the public money ; but when life, property, and national security are the interests at stake, we do not believe that pecuniary considerations will be allowed to impede the accomplishment of objects of such vast importance.

T. BYAM MARTIN, Admiral, *Chairman.*

HOWARD DOUGLAS, Lieut.-General.

J. D. DUNDAS, Rear-Admiral.

J. H. PELLY.

PETER FISHER, Captain, R.N.

J. N. COLQUHOUN, Lieut.-Colonel, R.A.

R. C. ALDERSON, Lieut.-Colonel, R.E.

JOHN WASHINGTON, Captain, R.N.

J. WALKER.

I dissent from this Report, because I consider the mass of evidence to be in favour of Dungeness ; and because I cannot recommend a large close harbour at Dover, where the pilots consider the holding-ground generally indifferent, and the engineers say it will silt up.

W. SYMONDS,

*Surveyor of the Navy.*

*August 7, 1844.*







# DOVER BAY,

IN APRIL 1844.

Surveyed in H.M.S. Blazer.

The Soundings are in Feet, and are reduced to the level of Low Water, Ordinary Spring Tides.  
the Datum line is 2 feet below the Zero of the Harbour Tide Gauge. The Tide rises 19 Feet in Springs,  
and 11 do in Neaps.

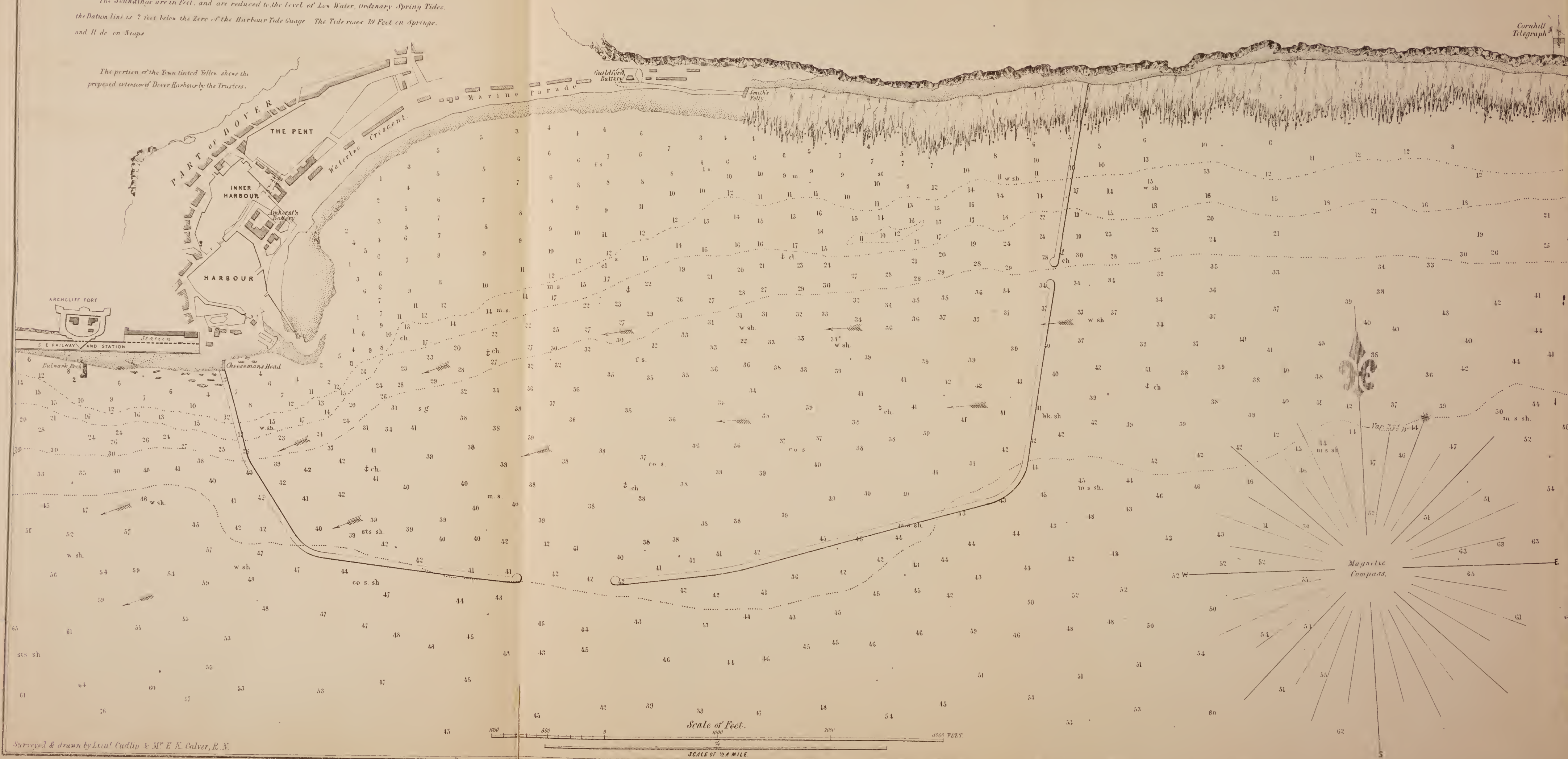
The portion of the Town tinted Yellow shows the  
proposed extension of Dover Harbour by the Trustees.

Castle Flagstaff

## AREA OF PROPOSED HARBOUR.

To Low Water Mark	520 Acres.
To the 2 Fathoms Edge	380 Acres
To the 3 Fathoms Edge	330 Acres
Width of the Southern Entrance	700 Feet.
Width of the Eastern Entrance	450 Feet.

The &s indicate the Spots, where the Holding Ground was tested in H.M.S. Blazer.



Surveyed & drawn by Lieut. Cudlip & Mr. E. K. Calver, R. N.

Standish & Co. Litho. London.







# DUNCENESS

EAST AND WEST BAYS.

May 1844.

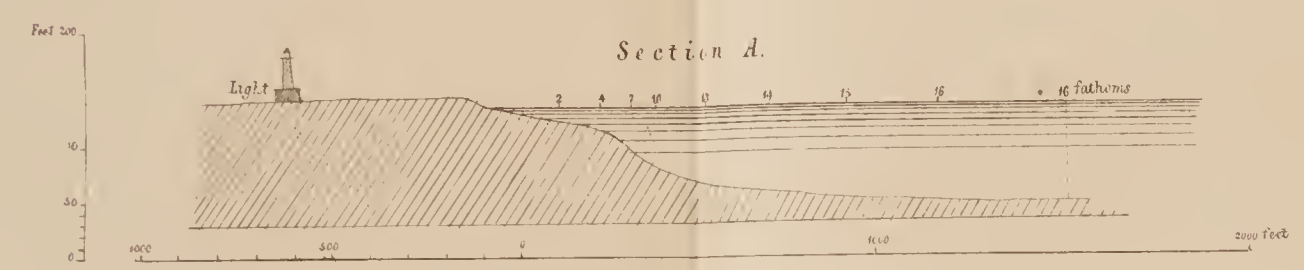
Surveyed in H.M.S. "Blazer"

The Soundings are in Fathoms, and are reduced to the Level of Low Water at Ordinary Spring Tides. The Tide rises 2 feet on Springs, and 14 feet on Neaps.

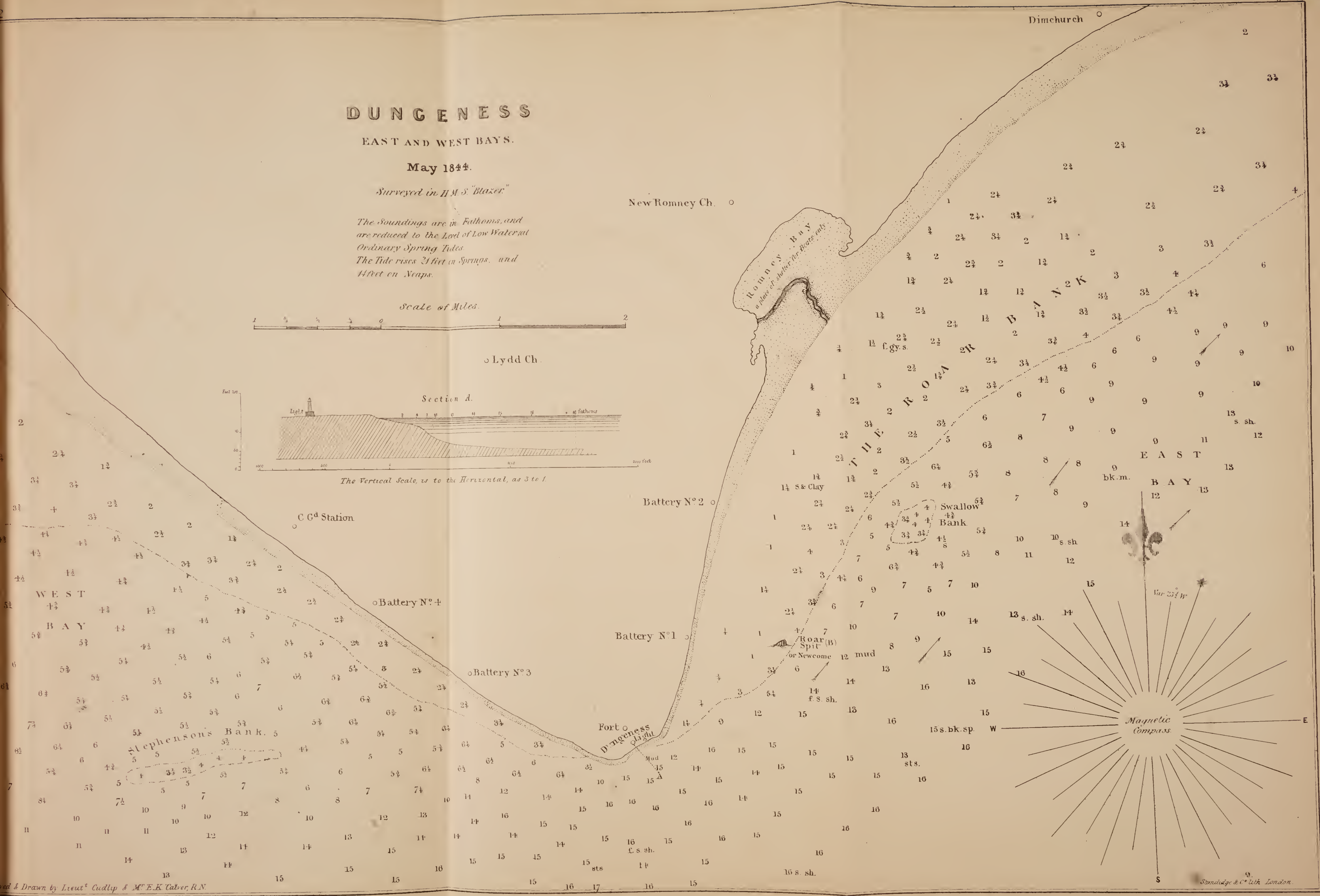
Scale of Miles.



Lydd Ch.



The Vertical Scale, is to the Horizontal, as 3 to 1.







# EAST-BOURN AND PEVENSEY BAYS

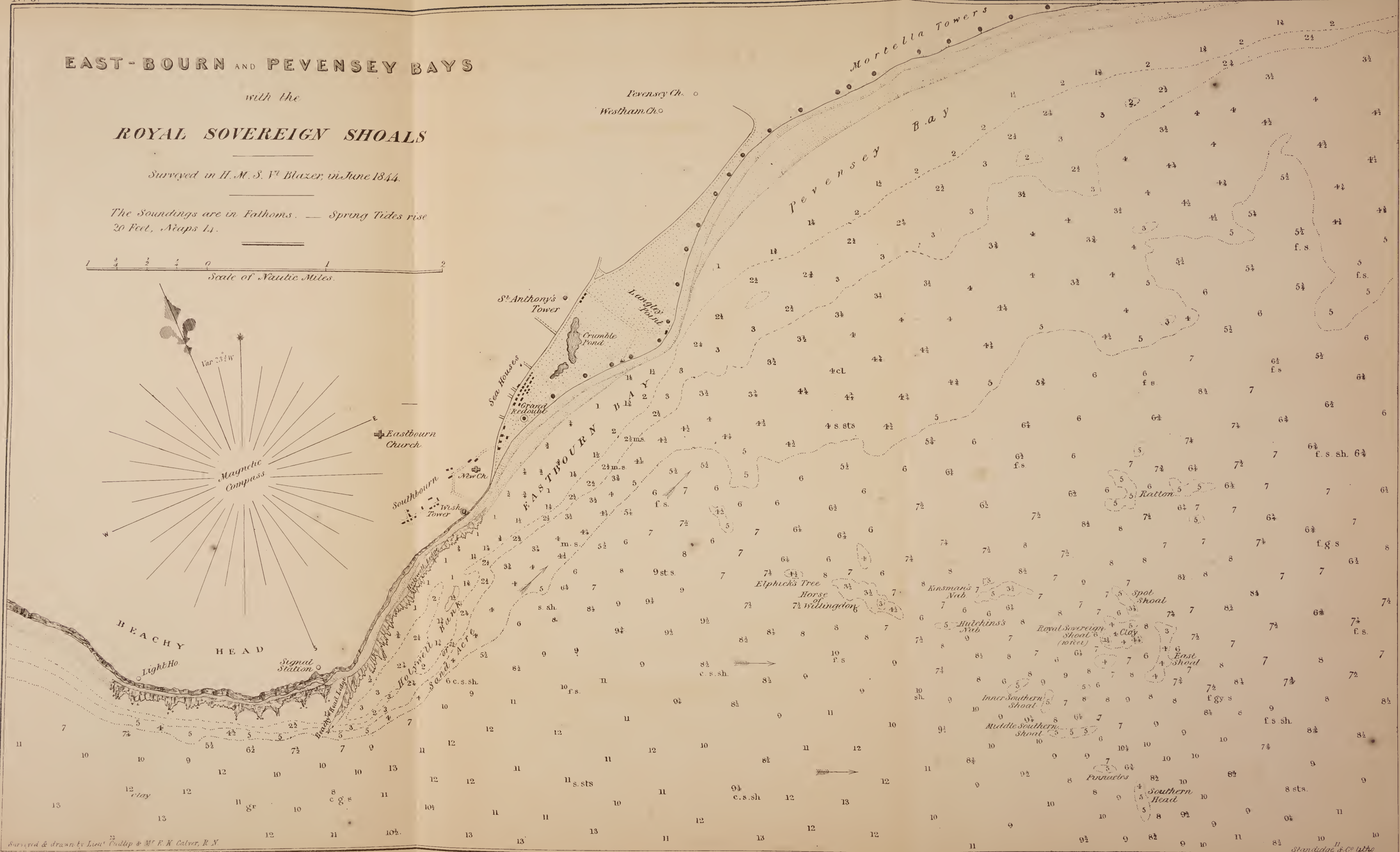
with the

## ROYAL SOVEREIGN SHOALS

Surveyed in H. M. S. V<sup>l</sup> Blazer, in June 1844.

The Soundings are in Fathoms. — Spring Tides rise 20 Feet, Neaps 14.

Scale of Nautic Miles.

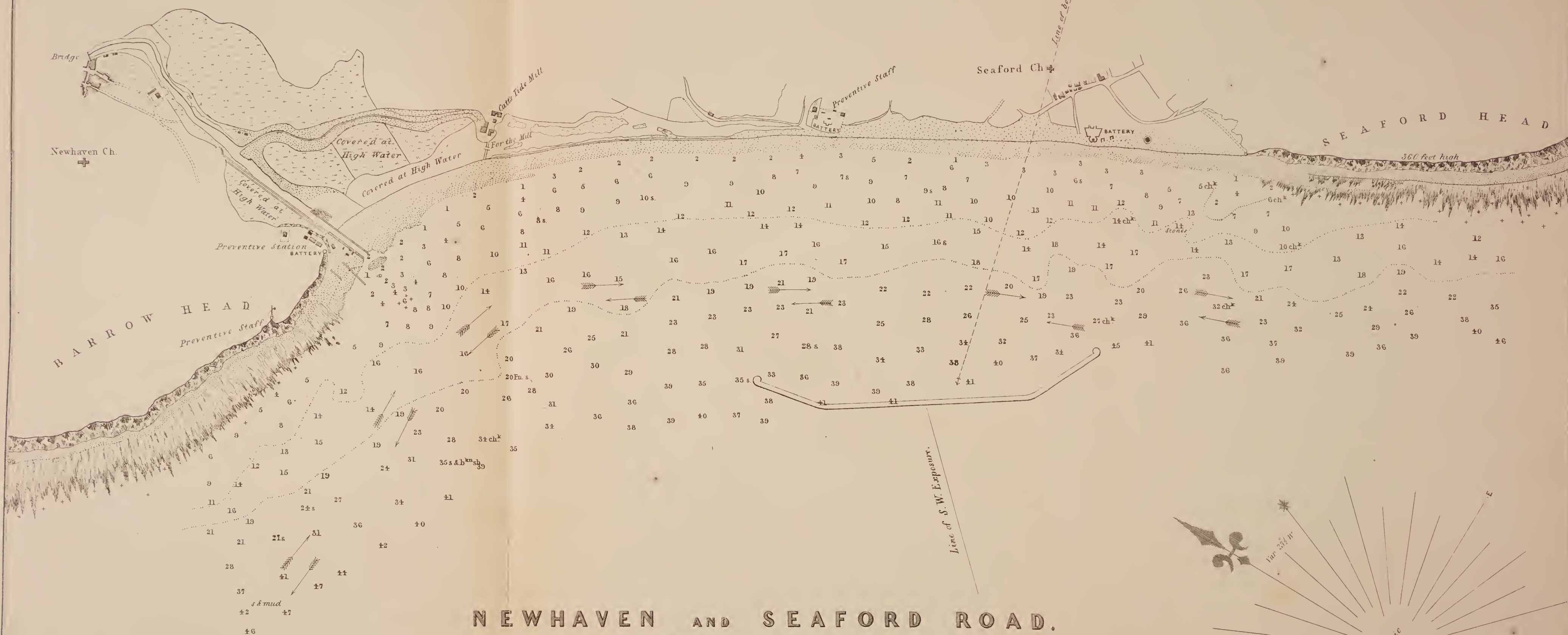






PROPOSED BREAKWATER.

Length 2000 Yards  
 Sheltered Area to the 3 Fathoms Edge about 250 Acres.  
 Adm. to the 2 Fathoms Edge 350 Acres

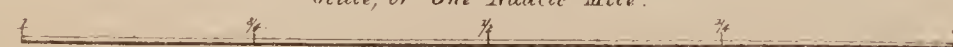


NEWHAVEN AND SEAFORD ROAD.

Surveyed in H.M. S. V. Fearless 1839.

The Soundings are in feet, at Low Water. Spring Tides rise 20 feet. Neaps 16 feet.

Scale of One Nautic Mile.

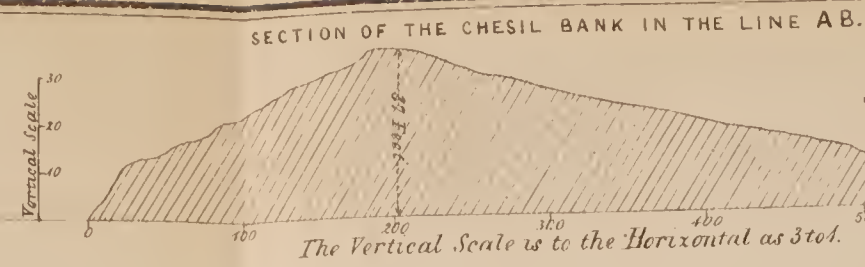






PROPOSED BREAKWATER.

Length 2500 Yards  
Width of Opening 50 Yards



PORTLAND AND WEYMOUTH  
ROADS.

Surveyed in H.M.S.V. 'Fearless'  
June 1844.

The Soundings are in Fathoms, and are reduced  
to the Level of Low Water, Ordinary Springs.

The Tides rise 7 feet on Springs and 4 feet on Neaps.

Scale of Miles.

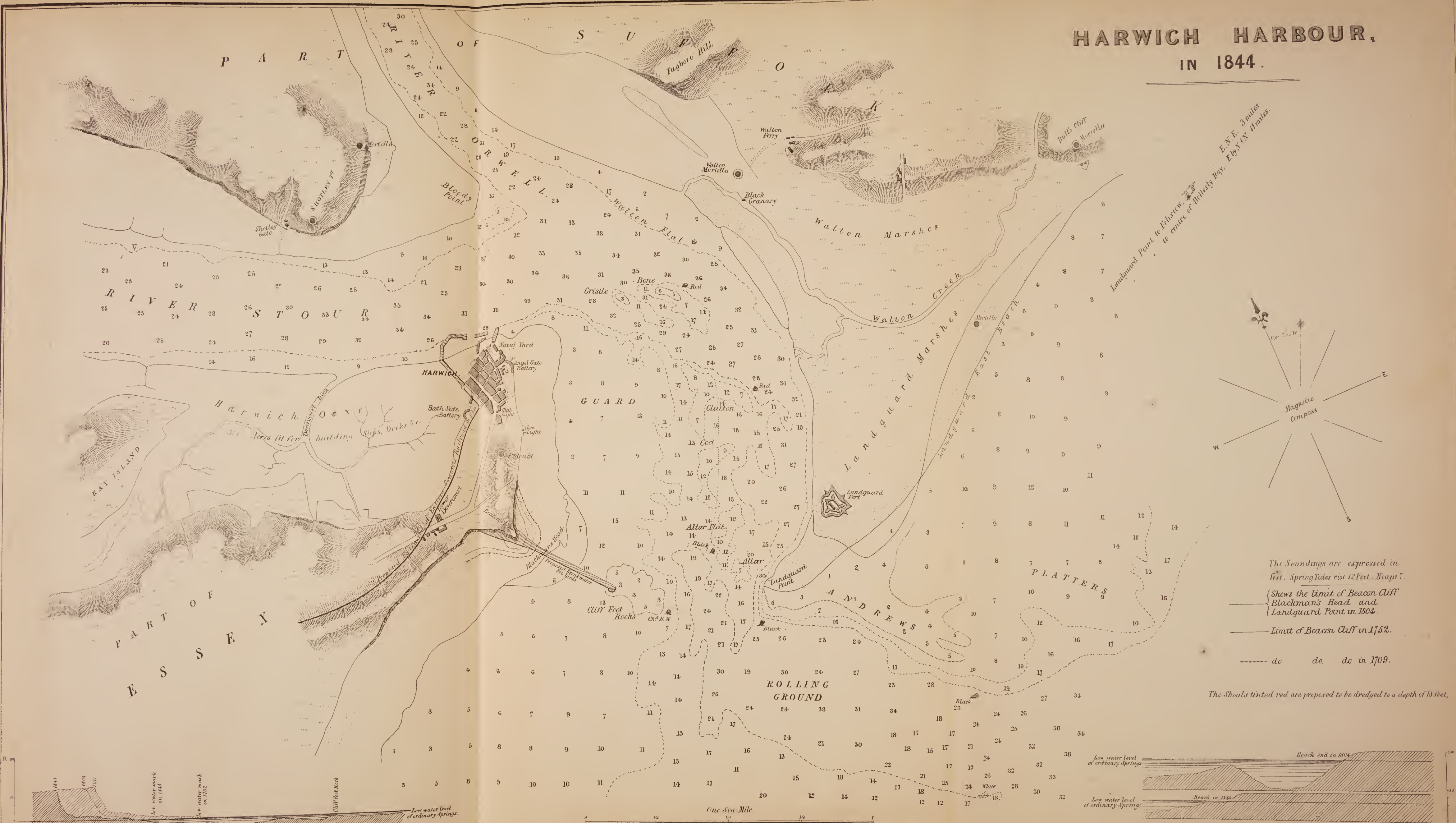
Surveyed & Drawn by Comm<sup>r</sup> Sheringham & Lieut Wood R.N.

Standage & Co. Litho. London.



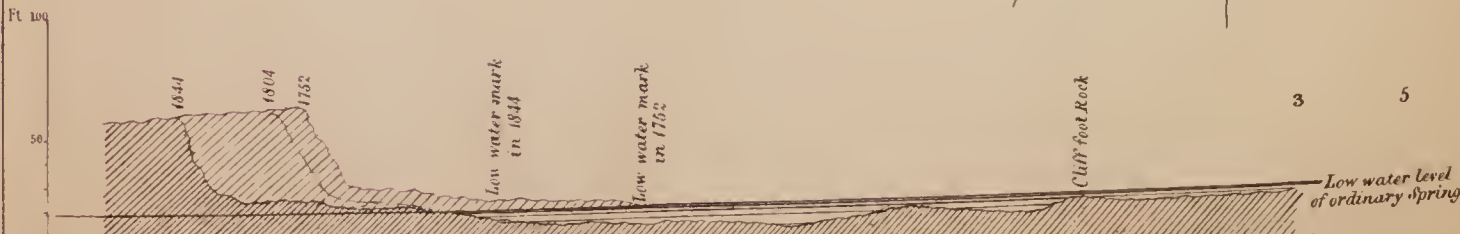


# HARWICH HARBOUR. IN 1844.

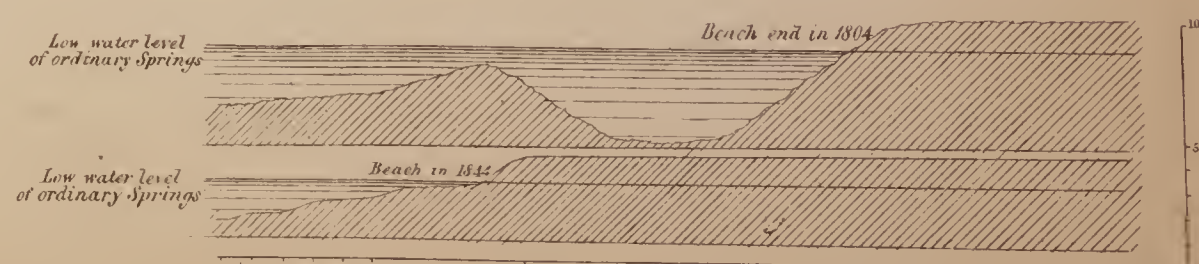


The Soundings are expressed in feet. Spring Tides rise 12 Feet. Neaps 7.  
 (Shows the limit of Beacon Cliff, Blackman's Head and Landguard Point in 1804.  
 ——— Limit of Beacon Cliff in 1752.  
 - - - - - do do do in 1709.

The Shoals tinted red are proposed to be dredged to a depth of 15 feet.



Section showing the Destruction of Beacon Cliff between 1752, 1804 and 1844.



Section shewing the increase of Landguard Point between 1804 and 1844.

Surveyed & Drawn by M<sup>r</sup> E. K. Calver, R. N.

Published by J. C. Fisher, London.







Nº 1.



**CHART**  
Shewing the relative position  
of the  
**CHANNEL PORTS.**





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## MINUTES OF EVIDENCE

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	Capt. Bullock, R.N.	9		Lieut. Hemer, R.N.	86
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	Mr. Meckiff	23			
	Mr. Bush	24			
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# MINUTES OF EVIDENCE

TAKEN BEFORE

## THE COMMISSIONERS UPON THE SUBJECT OF HARBOURS OF REFUGE.

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*Wednesday, 1st May, 1844.*

Admiral Sir T. BYAM MARTIN, in the Chair.

Captain *James Vetch*, examined.

Capt. *James Vetch*,  
R.E.

1st May, 1844.

1. (*Chairman.*) Are you now in the Royal Engineers?—I am.
2. You have a proposal to make to the Commissioners on the subject of the Harbours of Refuge?—I have been long considering the subject of the harbours of safety, and I have now a Memoir on the subject, which I beg leave to lay before the Commissioners. (*The witness delivered in the same.*) This is a Memoir which I published previously, which is referred to in that one; the plans which belonged to the Memoir are not published, but here are the manuscript plans which I beg leave to hand in. (*The witness delivered in three plans.*) This is a plan showing the boundary of the chalk line on the two coasts, and illustrating the geological formation. (*The witness delivered in the same.*)
3. Have you anything more to add?—Nothing at present.

[*The Witness withdrew.*]

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Rear Admiral *Sir James Gordon*, examined.

Rear-Admiral *Sir*  
*James Gordon.*

4. (*Chairman.*) Mr. Cubitt, in his Report to the late Chancellor of the Exchequer, speaks with great confidence as to the accuracy of his estimate for constructing the harbour at Dover, which he says will be under 1,500,000*l.* These are his words, “my estimates bear a very large additional allowance for contingencies, and I submit them with the fullest confidence that they will bear the strictest investigation.” Your Report, page 12, says each of those harbours, Dover being one, may be taken to cost none of them less than 2,000,000*l.*, and not much exceeding that sum. How do you account for this great difference between that sum and Mr. Cubitt’s estimate?—The estimate that I had anything to do with was given in 1840.

*Mr. Walker*, one of the Commissioners, explained that the other referred to a date of 1843, and was for a different plan.

5. (*Chairman.*) You appear to have visited all the ports and creeks on the south-east coast, from the mouth of the river to Selsey Bill; what place do you consider the best calculated for a harbour of refuge for the trade of the Channel, and at the same time the best suited for squadrons of vessels of war to protect the navigation of the Channel?—In the Report, we recommended Dover in the first instance; but I do not know whether we laid any particular stress upon Dover. “The situation,” we say, “which appears to us to be of the greatest importance, and at the same time to offer the most eligible position for a deep-water harbour, is Dover Bay.” That is in page 11 of our Report.

6. Which do you consider the next most important position?—The next most important, I think, was Beachy Head.

7. Which side?—East of Beachy Head.

8. Did your colleagues entirely concur in the opinion which you have now expressed?—I should say, decidedly; we may have differed in some small details in making the Report; in the manner in which it was made out.

9. But as to the positions which you have described, you entirely agreed?—Yes.

10. In speaking of the proposed harbour at Dover, you say that your opinion is in favour of two entrances, one to the east and the other to the west?—Yes, as it is recommended in our Report, I should presume that I did at that time agree to it.

11. Have you read Captain Beaufort’s and Colonel Thompson’s observations on Mr. Cubitt’s plan, in which they recommend only one entrance?—No, I have not; I never heard of it before that I recollect.

12. It seems to be the apprehension of those officers that two entrances would occasion the harbour to fill up with the drifting shingle; do you think that that would be the case, or that two entrances, which would give greater activity to the current, would rather tend to keep the harbour free from such accumulation?—I would rather not give an opinion upon that; I feel myself so perfectly ignorant about the drifting of the shingle, that I cannot speak upon it; it is an engineering question: perhaps it would be right for me to tell you that when I went upon this duty that was imposed upon me, we fixed upon the place which we thought the best for a breakwater, and then left it to those gentlemen who knew a great deal better than we did upon engineering points to decide. All that I heard of the shingle



Rear-Admiral  
Sir James Gordon.

1st May, 1844.

when I went down there was so very contradictory, and so very extraordinary, that it was quite impossible for me or anybody else to form an opinion upon it.

13. But, as a sailor, would you recommend one or two entrances to the harbour?—As a sailor, I should say that two entrances to the harbour would be much better than one; one to the eastward, and the other to the westward.

14. As two entrances, east and west, would naturally give greater velocity to the tide, do you think it would to a degree make it inconvenient for short-handed ships to bring up in blowing weather?—I do not apprehend that there will be the slightest danger.

15. If it should be determined to have two openings, do you see any objection to having the eastern entrance only 250 feet, being more than twice the breadth of the present harbour at Dover, bearing in mind that the eastern entrance will never have the same sea running upon it, and will never be so much in use as the other entrance?—I cannot give an opinion upon it.

16. Do you consider that a harbour of refuge with one entrance only would possess facility of ingress and egress at all times of the tide, and under all circumstances?—I should think that any harbour would be much better with two entrances, and we proposed to all those harbours two entrances, except to one under Foreness.

17. In the Dover projected harbour you have three entrances?—Yes; three entrances appear here.

18. (*Adm. Dundas.*) As a sailor, and knowing that the wind is for nine months in the year westerly, supposing there were two entrances to Dover Harbour, would not you think that the entrances which are to the south and east, would be the best approaches to the harbour of Dover, filling up the third altogether, which is to the west?—Yes; no doubt of it.

19. Is not the west entrance necessary for vessels to give them the full command of the anchorage in blowing weather, and also to enable vessels to get into the inner harbour?—Vessels can only get into Dover Harbour at certain times of the tide, and whenever they got inside the entrance of the proposed harbour, it would be so smooth that there could be no difficulty in their getting into the inner harbour when there was water enough for them.

20. (*Chairman.*) In your Report, favourable mention is made of Foreness as a desirable port for a harbour, did you think it preferable to any part within the Downs?—We did.

21. You appear to have objected to the enclosing of the Little Downs by a work on the Brake Sand, “on account of the magnitude of the work, the small depth of the water at the northern entrance, and the uncertain nature of the foundation,” was this the unanimous opinion of you and your colleague?—I presume it was, but I cannot vouch for it at all: I certainly, myself, was very decidedly of opinion that it would not do.

22. You had a very intelligent colleague, an Elder Brother of the Trinity House, the late Captain Drew, who was intimately acquainted with the Downs, and was qualified to form a sound judgment, did he completely concur in thinking such a plan unadvisable?—I should think he did, because I had so high an opinion of Captain Drew’s ability, and I knew him so intimately, that I think if he had proposed such a thing, he must have persuaded, not only me, but all the others, that it was the best place; but I should say, most decidedly, that he concurred with us.

23. This proposed harbour, the Brake, though I believe it is not called a harbour, appears, according to Sir John Rennie’s plan now on the table, to be open to the south-west, and as much exposed to the sea and wind from that quarter as any part of the Downs; did you consider that an objection to it at the time?—It appears in the Report that we have made here, that the breakwater was proposed to be run off from the shore. I have no recollection of that: it must have been proposed or it would not have been entered in the Report; but I have no recollection of it. But my objection to a harbour inside the Brake is this: if there had been any shelter inside of the Brake, I think our ships during the war would have taken up their anchorage there; but I do not remember that they ever did. As the wind blows directly through between the Brake and the shore, as it does between the Brake and the Goodwin, vessels were obliged to anchor well to the westward, so that if they parted and cast to port they might run through the Gull Stream, and to make it a harbour we must have run a horn from the end of the Brake, inland between Sandown Castle and Deal, (I am now speaking from recollection, of many years ago, and without having anything now to refer to,) which would have narrowed the entrance very much indeed.

24. You are aware that the north approach to this anchorage is so shallow as to have only twelve feet of water?—Referring to the chart, it does appear to be so.

25. Did you sound it?—I believe we did; but I am not sure.

26. Suppose the breakwater to be made there, if a ship of this draft of water, that is, twelve feet, were to break adrift in this anchorage in a south-west gale, what would be her probable fate?—We were recommended that vessels should run ashore there; they say it is the finest place in the world for ships to run ashore on that beach. We were informed that it much safer to take the ground upon Pegwell Bay than to run the risk of getting into Ramsgate Harbour.

27. A ship breaking adrift in the Downs on a flowing tide would have Ramsgate open to her?—Yes; if she did not draw too much water, she could go in no doubt of it.

28. You have been asked whether Captain Drew thought it unadvisable to make a harbour within the Brake, and what were the grounds of that unadvisability? was it simply, as you have stated, “that the magnitude and extent of such a work, which would require a breakwater and a pier of upwards of five miles in length, and the small depth of water at the northern entrance, and the uncertain nature of the foundation,” induced you to abandon the



idea? were those the only grounds for which you abandoned it?—The only grounds for abandoning were, I think, those which are stated in the Report.

Rear-Admiral  
Sir James Gordon.

29. Are you aware of the nature of the anchorage inside the Brake at present?—No; I am not.

1st May, 1844.

30. (*Capt. Fisher.*) Are you aware that, although men-of-war have not been in the habit of using the Small Downs as an anchorage, yet that, during the whole course of the late war, for many years it was the constant and usual anchorage of the merchant ships?—During the whole of my services I have never anchored in the Downs in a man-of-war but twice, so that I do not know whether ships were anchored in the Small Downs, or inside the Brake. I did not know it was the Small Downs till now.

31. Are you aware that, although the Small Downs in its present state cannot be considered a harbour of refuge, yet that it is a most excellent anchorage, very much protected from every wind, except the S.S.W., that from the S.S.W. to the south-east and others, it is in its present state a comparative place of safety?—It is a comparative place of safety, certainly, but at high water it must be as bad as any part of the Downs, I think.

32. Do you think, in case of war, merchant-vessels would lie in the Small Downs, and be protected from the enemy's steam-boats?—If the men-of-war were anchored outside of them, and merchant ships were in the Small Downs, I think they would be protected.

33. The anchorage within the Brake shows soundings of 20 and 21 feet; do you think that, in a situation exposed to the S.S.W., a safe place for merchant ships of 800 tons, for instance, in a heavy gale of wind?—Not where there is such a heavy sea as there is at Deal; and I do not think a ship would anchor there if she could help it, nor could I learn that any ship had ever anchored there; nobody ever came and told us that they had anchored there.

34. (*Adm. Dundas.*) You proposed a harbour at Beachy Head; did you make choice of the particular spot, in consequence of the recommendation of Sir Edward Owen, who so long commanded the squadron at that station during the war?—No; we did not.

35. Do you happen to know whether Sir Edward Owen has expressed an opinion as to any position?—I think he has.

36. What is the name of that position?—Cuxmere Haven. He recommended that part to the consideration of the Commission; but it came rather late, and we had not an opportunity of giving it that consideration which we wished to have given it,

37. Suppose each side of Beachy Head to offer equal natural advantages for a harbour, which side, as a seaman, would you prefer?—The eastern side, certainly; the other cannot produce such advantages.

38. Does not the Royal Sovereign Shoal, and another near it, make the place you have pointed out at Beachy Head objectionable?—No; I do not think it does.

39. (*Chairman.*) When you were in the neighbourhood of Beachy Head, did you examine Seaford, with a view to a harbour there?—Yes; we examined Newhaven.

40. You have in your Report spoken of Dungeness as a desirable position for a harbour, but stated that it was impracticable to make one there?—We considered it so.

41. Did you land at Dungeness, and look at that part of the bay which Sir Edward Owen talks of cutting an entrance into from the westward?—We did not land at Dungeness; but we went to the top of the lighthouse, where we could see all over the place, without being at the trouble of landing at a spot where we could see only the length of the boat; and we saw where the proposed harbour of Mr. Douglas and Mr. Potter was to be, but we considered it perfectly impracticable.

42. Had you the Reports of Mr. Douglas and Mr. Potter before you?—Yes.

43. Where are they now?—I do not know.

44. You said that you considered that in the Harbour of Refuge at Dover the westernmost entrance might be dispensed with; to ships seeking refuge from the westward, in case of gales of wind, would not the westernmost entrance be necessary, not only as affording them greater facility of getting in, but to enable them to get in at all, inasmuch as the tide would run directly across the mouth of the southern entrance, in the same way as it does at Ramsgate?—As both these are upon a line, the tide would equally run across both; there would be no difficulty whatever, I should say, in getting in at the middle entrance.

45. Did you ascertain in the proposed position at Beachy Head whether the shingle there is found as inconvenient as in other parts of the coast?—From it being made only a breakwater, we did not conceive that it could be affected by the shingle; it would be washed through it.

46. What materials are there near there to make a breakwater of?—So far as I can judge, none; but I am not an engineer: there is plenty of chalk there; but whether that will do to make a breakwater or not I cannot judge; I should say no, because it would all wash away; but faced with stone, I have no doubt it might do.

47. When you recommended a breakwater at Beachy Head, you had some idea that some substance might be got near at hand to make the breakwater of?—We knew there was none, because there was no stone on the coast of England fit to make it of.

48. Then it would cost more than 2,000,000*l.* to make it, would it not?—The engineer said not.

[*The Witness withdrew.*]



Captain  
Frederick Bullock,  
R.N.

1st May, 1844.

Captain *Frederick Bullock*, R.N., examined.

49. (*Chairman.*) What ship do you command at the present time?—I am now doing duty in a small vessel lent to me till another is built; the *Myrtle* is the name of the vessel.

50. How are you occupied?—In surveying from the Naze of Harwich to the South Foreland.

51. You have been employed in surveying different parts of the south-east coast?—Yes; I was employed in examining the different harbours on the former Commission.

52. If with your intimate knowledge of the south-east coast you were called upon to fix upon the most favourable position as a rendezvous for a squadron of ships of war with a view to the protection of our own shore, or offensive operations, and at the same time afford a convenient refuge for commercial vessels passing through the Channel, where would you construct a harbour calculated for those purposes?—With reference to all those points, I should say Dover; I reported favourably of Dover before.

53. Do you think Dover Bay favourable for the construction of a harbour?—I think so; I think it is very possible to construct a harbour there.

54. In answer to a question put to you, 4395, you state that you do not consider Mr. Cubitt's plan for a breakwater or screen, as you call it, in front of Dover Bay practicable; why do you consider it impracticable?—There was a great deal of desultory conversation when I was examined; and my recollection is, that I stated that I did not approve of caissons on account of wood not being durable, and that was, I think, my only objection, not the impracticability of the plan.

55. What do you say of his plan of a close harbour encircling Dover Bay; have you thought of that?—Yes; I do not give any opinion upon engineering. I will not speak to the practicability of it at all; but it strikes me that if it can be accomplished, and be permanent, it is the very thing that is required.

56. There is a question put to you, 4426, "Suppose a vessel leaving Portsmouth, bound to the eastward, is caught in a heavy gale from the southward, and cannot go to Dover, what would be the use of a harbour of refuge there?" Your answer is, "She must run to the Downs." Undoubtedly, missing Dover, there can be no alternative for her but to run to the Downs; but suppose a ship caught in a southerly gale, what could prevent her entering an artificial harbour in Dover?—There would be nothing to prevent her getting in if there were a good entrance.

57. Have you made, under the direction of the Admiralty, a complete survey of the Downs?—It is not completed yet.

58. But you have made a survey?—Yes, sufficient for the purposes of answering the questions of the Commissioners.

59. It appears by your survey that there has been a considerable change in the position of the Brake sand?—Yes; there has been a good deal of alteration; but the sands still preserve the same features.

60. Is there the same space for anchorage within the Brake as there was before the sand shifted, as described in your Report?—No; certainly not, because the sand has moved within or towards the main land.

61. Is the space more contracted?—Yes.

62. Is there, in point of fact, a sufficient depth of water within the Brake for ships of a large class?—Yes; to the southward and westward of the Brake sand.

63. Suppose a S.S.W. gale blowing into the Brake, is there a good anchorage then?—Yes; for large ships, in 30 and 35 feet, to the westward of the Brake buoy.

64. Have you ever seen Sir John Rennie's plan of the Brake?—No; I have not.

65. How much is the channel narrowed?—A third of a mile.

66. Having the channel so much narrowed, do you still consider it a place fit for spacious anchorage?—No; it could be made a safe anchorage for small vessels, but not a large harbour of refuge for line-of-battle ships.

67. If it was built round in the same way that Dover Harbour is proposed to be, is there not greater capacity there for making a larger harbour than there is at Dover?—I think not.

68. According to the plan proposed for Dover Harbour, what number of vessels do you think it would contain?—I have not calculated it, because it depends upon how far you carry out the screen.

69. You have stated, and you adhere to that report, that the northern entrance to the Brake has only 12 feet of water in many parts?—The Old Cudd Passage has not so much, it has about 9.

70. Supposing a ship lying within the Brake exposed to a S.S.W. wind and sea, to happen to break adrift, she cannot escape by the North passage?—That is the great objection to the harbour. She cannot escape but through the Old Cudd at high-water.

71. Which do you consider the preferable place from your knowledge of both for the expenditure of a large sum of money for an artificial harbour, the Brake or Dover?—I have given my opinion before in favour of Dover. At the time that I reported upon all the harbours round the coast I was in favour of Dover.

72. Is it your opinion that the position of Dover is the most favourable of any as a rendezvous for a steam squadron for the protection of trade?—For the protection of the narrow seas, certainly.



73. What water have you in the Cliff's End Channel, which is another channel through the Brake?—11 feet.

74. Sir John Rennie, in speaking of the increased rate of the current within the proposed harbour, that is the anchorage at the Brake, says, "it will probably deepen the anchorage two or three feet;" if it should have that effect, do you think that the sand thus carried away at the flood-tide would be likely to settle down at the entrance of Ramsgate Harbour?—If it is carried away, it will be carried through the Old Cudd Channel or over the Shallows, on the shore beyond the harbour's mouth.

75. Not to the front of Ramsgate Harbour?—I think not; because there is no appearance of sand at all, except at the back of the harbour of Ramsgate, it seems all to go to the northward of the harbour.

76. But supposing, as Sir John Rennie says, that the sand moved so as to deepen the water two or three feet, what would become of it?—It would pass to the northward and eastward.

77. When it meets with a counter tide, or the tide acting upon it ceases, it must deposit itself?—Yes.

78. Where is that likely to take place?—At the back of the harbour, that is where all the sand is now.

79. Then it will come upon Ramsgate Harbour?—Not upon the entrance of the harbour any more than it does now.

80. You suppose that it will come to the sands at the back?—Yes, the sand is there increasing.

81. Do you think that a harbour could be made there with any degree of propriety?—Yes, for small vessels, such as could avail themselves of Ramsgate Harbour in cases of necessity.

82. (*Sir H. Pelly.*) Do not you think that at the south end of the Brake a harbour could be made off Sandown Castle for vessels of a large class?—Yes; if you carried this breakwater further out into deeper water, towards Deal Sand, it could be made.

83. Quite as large or double the size of Dover Harbour, capable of holding all the men-of-war, and all the merchantmen that come into the Downs?—Yes.

84. (*Chairman.*) Suppose a harbour of that description to be constructed, what is to become of the immense masses of shingle that are known to be driving up along that north line of coast?—If the harbour was extended out and prolonged from the shore, the shingle would then be stopped for the time.

85. And when the shingle is filled up as in all other groins, it would travel round the other point and get into the harbour?—I think there is a great difference of opinion as to the travelling of the shingle on our coasts; but my opinion is, that if the west head of the harbour was to be built out in the acute angle which the shore makes with the prevailing wind, the shingle would accumulate. Shingle is only moved by the waves, and then only acquires a progressive motion. Tide has scarcely any influence over shingle, and if the west head was prolonged into deep water, as above stated, it would probably never pass round it, for the direct influence of the waves would be to accumulate it on the shore.

86. (*Capt. Washington.*) But experience tells us that the shingle does not go to the northward of the Sandown Flats?—Yes; there is a place where it ends, termed Shingle End.

87. (*Sir H. Pelly.*) Considering the constant west wind and the position of the ports on the opposite coast, which of those two proposed harbours, that at Dover or the Brake, should you say would be the best with a view to protect the commerce of the country and annoy the enemy?—Dover.

88. Do you consider Ramsgate a good refuge harbour, taken at the proper time of tide?—Very good for vessels of a certain tonnage.

89. What brings the heaviest sea into the Downs?—South-west gales.

90. When vessels break adrift in the Downs, is it not in southerly gales with a heavy sea and a flood-tide running against them?—Yes, it must be the case with the two forces acting together.

91. Then when vessels break adrift in the Downs, the tide which breaks vessels adrift in the Downs is the flood-tide, which gives them a depth of water to get into Ramsgate Harbour; the same tide which breaks them adrift enables them to get into Ramsgate Harbour?—The question requires two answers; the first is, that it is certainly the tide that will take them into Ramsgate Harbour, but it must be at such a time of the tide that they will have water to get in.

92. But it is on the flood-tide, and the very tide which breaks them adrift is the tide which gives them water into the harbour?—Yes, but as the tide runs in the direction of the flood until half ebb, there would not be water all that time.

93. Speaking of the Brake Sand, do you know anything of the nature of it, of its solidity and stability, for the construction of works upon it?—We did pierce it to about four or five feet, and found it all sand; we never got below that. To the southward of the Cudd Channel and the second shoal, it is all sand.

94. (*Capt. Washington.*) Do you mean the Quern?—The Quern is chalk rock.

95. The Cliff's End Channel is to the southward of the Quern?—Yes, that is where the sand begins; that is the valley of the chalk.

96. Do you think it possible to deepen the water in any degree at the entrance of Ramsgate Harbour by a dredging-vessel?—If the dredging-vessel could be adapted to cut away the chalk it could be done.

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97. (*Col. Colquhoun.*) By small buckets being strongly armed with steel it might be done, might it not?—Yes, I think it could be accomplished.

98. (*Capt. Fisher.*) You were asked, whether if vessels break adrift in the Downs, they break adrift in the same tide that carries them into Ramsgate Harbour; how long does the tide-stream run to the southward after it is flowing by the shore?—Nearly three hours.

99. If the wind is to southward, would not a vessel be riding on the ebb-stream till half-flood by the shore?—Yes.

100. And therefore low water by the stream is just the time for her to get under way to go into Ramsgate Harbour?—Yes, between that time and high-water, viz. three hours.

101. When the stream ceases they get under way, because it is flowing half-tide into Ramsgate Harbour?—Yes.

102. Consequently the tide can have no effect upon running her adrift?—No; not at that moment. The question as I understand it is, whether there would be sufficient water to get into Ramsgate Harbour, *i. e.* if the vessel had broken adrift on the flood between the time of half-flood and high-water.

103. Ramsgate Harbour can never be a harbour of refuge for large vessels?—No; but there can be no doubt of its utility, and it would be very greatly improved by continuing the Brake.

104. (*Adm. Dundas.*) With your relative knowledge of the situation of Dover, and the anchorage in the Small Downs, are you of opinion that under any circumstances a harbour of refuge could be made in the Small Downs preferable to that off Dover?—Certainly not; with respect to its position, if to a harbour of refuge you add a harbour of defence, I should prefer Dover under any circumstances.

105. You have heard of a harbour on the Goodwin Sands, do you think that feasible?—I think after you had made the harbour on the Goodwin Sands, you would then require to run out a very extensive breakwater to protect the harbour you had made, because the wind that opens upon the Downs opens upon the sands.

106. Do you find that the Brake sand has become narrowed, or has come bodily in towards the shore?—The latter; it otherwise maintains its general appearance.

107. The Gull Stream then has widened?—Yes, it is a better channel now; and I think the Trinity Board have found that by the removal of the buoys.

108. Have the Goodwins shifted?—Yes; they have moved a little to the south.

109. (*Chairman.*) Have you surveyed the coast to the north of the North Foreland?—Yes; the whole of it.

110. What is your opinion of Foreness as a place for the construction of a harbour; from your knowledge of that coast should you say that that position is favourable for the construction of a harbour?—Yes; I think it could be done.

111. Would the projection of a harbour into the sea from that point occasion any injurious change, do you think, in the direction of the tide?—It would interrupt the tide.

112. Would it throw it off in any direction to be injurious?—It would affect it a good deal, because the projection would be at right angles to the tide; there is no sand there, it is all chalk throughout; it is possible to build a harbour there.

113. (*Sir H. Pelly.*) You stated that, from the locality, Dover would be better than the Brake; would not the Downs be a great deal better than Foreness?—Certainly; there cannot be a doubt of that.

114. In speaking of the northern entrance to the proposed Brake harbour, is there any other channel than the Old Cudd Channel which is said to have 9 feet depth of water?—Yes, there is one called the Cliff's End Channel.

115. What depth of water is there in that channel?—Eleven feet.

116. Therefore it is a good channel?—Yes, compared to the Old Cudd.

117. Is the bottom sand or chalk?—Sand.

118. (*Capt. Washington.*) Would there be any difficulty in dredging a deep channel there, it being sand?—I think there is always a difficulty in removing sand.

119. But supposing a breakwater erected with piers, would not that channel scour itself out into a deep channel, with very slight assistance from art?—There is a great probability of it being benefited by the construction of a breakwater.

120. The Cliff's End Channel is immediately to the north of the extreme end of the Brake?—Yes; just to the north; but there is a disadvantage as regards the Cliff's End, that it is more at right angles with the direction of the tide than the Old Cudd.

121. You spoke of the shingle travelling along the coast; does it extend as far as Ramsgate Harbour?—There is no appearance of shingle at Ramsgate Harbour.

122. Do you know where it ends?—Yes, between Sandown Castle and the entrance to Sandwich Harbour, towards Shellness.

123. Where do you think the shingle goes to?—I cannot say; I followed it to the very last point of the shingle.

124. Have you ever noticed how far the shingle extends out from low-water mark, generally speaking?—No, I do not think I have noticed that; but at a very short distance we have sand and then mud.

125. Have you ever seen the shingle extend so far as low-water mark?—No, there is a line of sand always at low-water mark.

126. Can you assign any cause for the extraordinary change in the position of the Brake sand?—I cannot.

127. Do you think that it is possible that it might have been an error of the engraver in using in Græme Spence's chart?—I think not: it was done very carefully; nor do I rehend it was an error in Græme Spence.



128. Have you ever seen the original of Græme Spence's chart?—I have not;—that is the engraved copy.

129. Does the original exist?—I think not.

130. When you spoke of ebb and flood-tide in the Downs, did you mean, when you said the flood tide, the south-west stream or the north-east?—There is one portion of that south-west, and the other north-east.

131. But when you speak of the stream going to the south-west, do you mean that to be the flood or the ebb?—I think, generally speaking, it is the ebb that is said to run to the south-west, and the flood to the north-east.

132. (*Chairman.*) Is it the general opinion of well-informed pilots and seafaring people on the coast that the Brake Sand has shifted?—They had no idea of it; nor, till I examined it, was there any idea of it. It had never been observed; the alteration has been so gradual.

133. Has the buoy been shifted from the south end of the Brake in consequence?—I think the middle Brake buoy has been shifted, not the south Brake buoy.

134. How long is it since it has been found that the sand has been shifting?—In 1840 it was discovered; I examined it in 1840.

135. Have you had any examination since 1840?—No.

136. (*Capt. Washington.*) Was there any examination between 1795 and 1840?—No.

137. Did Mr. Thomas survey the Brake?—I think he did not; he did not make a regular survey of it.

138. (*Adm. Dundas.*) Have you surveyed the coast round Beachy Head with reference to a harbour of refuge?—Yes.

139. If it were determined to construct a harbour at Dover to enclose Dover Bay, would you recommend an entrance at each end; or how many entrances would you recommend?—Two would be quite sufficient.

140. You approve of that plan that lies before you?—Yes; I think I should prefer having the entrance a little wider than 700 feet.

141. From the way the shingle travels at Dover, would you fear that the western entrance (A) would be filled up?—Not if this angle was made more acute to the coast: but as it is now, I think it would; the influence of the tide would take the shingle down to the point, and then it would wash round. I do not at all think that it would fill up, but it would wash round the point.

142. Supposing a ship came from sea with a strong gale from the westward, do not you think she might get into the harbour by the entrance (A a), which is the middle entrance?—Yes; but (A) is of advantage to get out.

143. Do you consider that, the western entrance shut up, the harbour would be as available for a ship coming in with a heavy gale of wind from the westward as if that entrance were open?—No; I should prefer the entrance open.

144. If the harbour is carried out into 6 fathoms at low-water spring-tides, should you have any apprehension of its being inconvenienced by shingle at that depth?—No, I should not.

145. (*Chairman.*) Have you surveyed the coast round Beachy Head?—I have.

146. Is there any part which presents a strong natural advantage for the construction of a harbour?—I think not, because to the eastward of that Head, where it appears so good, there is a sand which renders it impossible to succeed.

147. Do you think the position pointed out by the late Commission for a breakwater at Beachy Head objectionable from its being in the neighbourhood of the Royal Sovereign shoal, and of another shoal?—My report on this head was, that the sand was the objection.

148. You say, in answer to question 4493, before the Shipwreck Committee, "I thought very favourably of Beachy Head till I found the sand-bank under it;" will you be good enough to explain what you mean by the sand-bank under it?—We found a shoal of sand-bank to the eastward of the Head.

149. You mean that you found the sand ranging along under it?—Yes.

150. How far off did this sand extend?—About half a mile.

151. So as to inconvenience the anchorage?—Yes, it inconveniences the anchorage certainly.

152. What is the depth of water beyond the half-mile of sand?—Eight or nine fathoms.

153. Then you think unfavourably of that particular part; is there any other part of Beachy Head that you could fix upon?—No, not at Beachy Head.

154. Not on either side?—No; I think not.

155. Can you recommend any improvement that would make Newhaven capable of receiving large steam vessels?—No; it is a dry harbour.

156. Is it capable of being improved by any artificial contrivance?—I think not, on account of the shingle.

157. (*Capt. Washington.*) You have stated that Holywell Bank, which, according to your survey, lies half a mile to the eastward of Beachy Head, renders the bay to the eastward of Beachy Head unfit for a harbour of refuge?—Yes, where the shoal extends.

158. Why should not the breakwater be carried to the eastward deeper in the bight of the bay, and thus convert Holywell Bank into a natural breakwater?—That might be done; the sand would itself then become a breakwater.

159. Is there within this breakwater any creek or opening?—No; it is a plain coast.

160. Is the holding ground within that proposed breakwater good?—Yes.

161. (*Chairman.*) Have you any other objection to Beachy Head as an anchorage but that bank under Beachy Head?—None.

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162. What would be the distance between the sand and low-water mark?—It is very little; it is close in.

163. Was any ship ever lost or struck there?—Not that I am aware of.

164. (*Sir W. Symonds.*) Do you think a harbour of refuge could be made at Dungeness?—I have hardly examined it sufficiently to answer that question; the great objection would be its shallowness, under the lee of the shingle of which the point is composed.

165. Do you think it is possible to cut through the shingle a passage such as Sir Edward Owen describes?—It would be possible to cut it through, but I do not think it would be possible to keep it clear of the shingle afterwards.

166. Looking at the two situations, Dover and Dungeness, supposing only one harbour of refuge was to be made, to which situation would you give the preference?—Dover, on account of its fortification, as combining two great purposes—refuge and defence.

167. Is there not hard chalk at Beachy Head?—Yes.

168. (*Chairman.*) Will you be so good as to look at the plan of 1840, and see the position in which the Commission have proposed a harbour at Beachy Head to be constructed. Referring to that plan, do you consider the Holywell sand to be an objection?—Certainly not, in that case.

169. Then what is the sand which you consider to be an objection?—The plan was making it close to the point, not removing the breakwater further to the eastward. I examined whether I could make a harbour at Beachy Head, and I imagined that it was proposed that it should be close to Beachy Head, and that in that case the Holywell Bank would be an objection, not otherwise.

170. Is there not plenty of material close at hand for erecting a breakwater at Beachy Head?—Certainly.

171. (*Sir W. Symonds.*) Do you know Swallow Bank in Dungeness East Bay?—Yes.

172. Is there good anchorage between that and the shore?—Yes.

173. Considerable space?—Yes.

174. Might not advantage be taken of Swallow Bank itself to make a breakwater of not more than two miles altogether, which would enclose a considerable space?—I am not acquainted with the character of the Swallow Bank, but I am of opinion that it might be made available.

175. Which side is it?—To the eastward.

176. Do you know any good anchorage without artificial means in a westerly wind besides Dungeness between the Owers and the South Foreland?—I know of none.

177. You admit that Dungeness is good anchorage?—Yes.

178. From the west, how far to the southward of the west?—That will depend upon the size of the ship, three fathoms or five fathoms would make a great alteration in the bearing.

179. Do not vessels occasionally take shelter under Dungeness, when they are going down Channel with west and south-west winds?—Invariably; I have myself taken shelter there.

180. (*Chairman.*) Do you know anything of the Owers, whether the anchorage by the Owers is capable of being converted into a good anchorage?—I have never examined the place, but I have heard that it is very good anchorage; it is hearsay evidence, but a very old friend of mine saved a ship there; it is a very good entrance, and very smooth water within the Owers.

181. Have you surveyed any part of the coast to the west of the Isle of Wight?—No.

[*The Witness withdrew.*]

Adjourned till to-morrow at 11 o'clock.

Thursday, May 2nd, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Mr. Jeffreys, C.E., examined.

Mr. Jeffreys, C.E.

2nd May, 1844.

182. (*Chairman.*) What have you to propose to the Commission?—A proposition for the improvement of Dover Harbour. The shingle which forms a bar at the mouth of Dover Harbour rests on a bed of chalk to the south-east of the harbour. I propose that a channel be cut through the bed of chalk in an easterly direction, so as to give a free passage to the shingle into the bay. The water from the culverts, if properly diverted, and let off just after flood-tide makes, would clear away the accumulation of shingle; the bed of chalk is about 3 feet above low-water mark at spring-tides. The water from the culverts is at present let off, just before low water, and carries the shingle from the apron directly upon this bank; the remainder of the ebb then carries the shingle to the west to be re-accumulated. If a channel were cut as proposed above, the shingle would be carried out, the harbour's mouth cleaned, and a double entrance given for shipping. Also to shorten Cheeseman's Head, and allow the sea to sweep the shingle along the beach past the mouth of the harbour (through the channel proposed to be cut) into the bay.

183. How long is it since you inspected the chalk bank referred to?—In August, 1843.

184. When did you see the chalk bank free of shingle?—Never but once; it was on the day of the Harbour Session at Dover; I think in 1837.

185. What width do you propose to make the cut?—100 yards.

186. To what depth do you propose to excavate the chalk bank?—Five feet below low-water spring-tides, with a slope of one foot in two at the sides; the bottom being level.

187. Have you ever, under any circumstances, known the harbour to have two entrances?—I have, for small vessels under 100 tons; one mouth to the harbour with an entrance



from the east between the bed of chalk and the north pier head, as well as an entrance from the south at two-thirds flood. Mr. *Jeffreys*, C.E.

188. What is your opinion as to a breakwater being run out from Cheeseman's Head? and the effect upon the shingle if an opening was made therein?—The shingle would accumulate on the west side of the Harbour wall, and travel along until it reached the mouth of the harbour, when it would be thrown into it, where it would lie at rest, and in time tend to fill the mouth. I instanced the accumulation of shingle at Dungeness, as I have stated in my communication of the 6th and 20th instant. My evidence relates to the improving the access to the present harbour; but my proposition for a harbour of refuge in the Bay has not been submitted to the Commissioners, and I beg respectfully to be allowed to do so.

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The foregoing answers were illustrated by a plan of Dover.

[*The Witness withdrew.*]

Captain *Frederick Bullock*, R.N., re-examined.

189. (*Chairman.*) It is said, in question 1769, page 111, in the evidence before the Select Committee to Report on Shipwrecks, "Captain Bullock, after making a complete examination of Newhaven, was of opinion that that was the most eligible as a harbour of refuge westward of Beachy Head?"—I consider it, of the two, viz., Newhaven and Shoreham, as the best.

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*Frederick Bullock*,  
R.N.

190. It is stated by Captain Hood, R.N., that you have bored in front of Newhaven?—This is a mistake, I never have; but I should say that the substratum was chalk rock.

191. Taking into consideration the object we have in view, the protection of the trade and harbours for cruisers, which do you consider the most proper for the purpose, that opposite Newhaven or that opposite Eastbourne?—Eastbourne.

192. What materials are there on the spot for making breakwaters?—An abundance of chalk and shingle.

193. Will the Sovereign Shoal be a difficulty with reference to any harbour opposite Eastbourne?—Yes; but the difficulty may be lessened by properly buoying and lighting that and other shoals. I consider that such precautions will remove any objection to the situation on that point.

194. Will you state your reason for preferring Eastbourne to Newhaven?—It is more sheltered from the westward, by Beachy Head, and secondly it is nearer the narrow part of the Channel, so that protection can be more readily afforded against an enemy's cruisers.

195. Do you consider such a harbour would be as easy of access as Newhaven for ships requiring shelter?—I consider it would, be not only equally easy, but, if blowing strong from the westward, the facility of getting it would be far greater.

196. In giving preference to the harbour eastward of Beachy Head, could vessels haul out again as easily, without being embarrassed by a lee shore?—Certainly; I consider this another reason for its preference.

197. Do you know who first proposed a harbour of refuge at Eastbourne?—No; I do not.

[*The Witness withdrew.*]

Tuesday, 7th May, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Captain *William Hood*, R.N., examined.

198. (*Chairman.*) You have delivered to the Commissioners various papers respecting Newhaven. You say your opinion is founded on observations made on the spot while you were officially employed there?—Yes.

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*W. Hood*, R.N.

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199. Your object seems to be to obtain a powerful sluicing operation by converting Sleepers' Hole into a reservoir for back-water?—Yes.

200. By these means you propose to push the shingle and sand away from the mouth of the harbour?—Yes.

201. What do you suppose will become of it?—It will be taken by the tide up Channel, as the whole of the shingle is known to drift to the eastward along that coast.

202. How far from the pier does this ebb-tide or outset extend, do you suppose, and into what depth of water?—I should say its influence outside extends 800 feet.

203. Into what depth of water will that carry you?—about six feet at low water.

204. When the ebb-tide and the power of the scouring water is spent, or is checked by the tide, will not the sand or mud immediately settle down and add to the shoal water already existing at that distance in front of the harbour?—No; I propose digging into the primitive clay so that that will form a channel itself below the piers. I have a boring apparatus for that purpose.

205. When the ebb-tide passes the east pier, does not the water expand into the bay?—At present a good deal.

206. Between Newhaven and Seaford, does it not?—It does.

207. There is a tendency to shoal water by the deposit of the harbour mud?—There is;



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the mud out of the harbour has very slight effect. There are groins also all along the beach, between that and Seaford for the stoppage of the shingle; this will be shown on the model.

208. Then if the east pier is extended, will not that prevent the spreading of the water and the shoaling in the bottom of the bay?—My proposal is to widen and extend both piers so that there may be the length of a sea without its breaking against either pier head.

209. To what distance do you propose to lengthen the piers?—About 500 feet beyond the present piers.

210. Are you aware that this lengthening of the piers has already been proposed by engineers who have been down there?—I am aware of that; but my present plan is founded on the knowledge acquired, having been for many years the executive officer in a frigate at Newhaven, when my attention was called to the properties of the port by the late Lord Chichester through Mr. Thomas, his relative.

211. These are your drawings? (*Two drawings being shown to the witness.*)—Yes.

212. At what distance from the west piers seaward do you get five fathoms water?—I should say at 1500 feet or thereabouts. I cannot be more precise without referring to my report; I have frequently sounded off the harbour.

213. Are you aware that Mr. Whitby, who was employed to examine Newhaven in 1823, recommended that the part you intend for a reservoir should be converted into a wet-dock?—I was not aware of that; this is the first time I have heard of it.

214. He says, “I would recommend that a dock should be made a little within the entrance of the harbour on the western side, at the place called Sleepers’ Hole. If such a dock were made at Newhaven, I am of opinion that the trade of the country would be greatly benefited thereby”?—I am aware that that was the original channel of the river, and that a sloop-of-war lay there about sixty years ago.

215. Are you aware that Mr. Jessop has since that proposed Sleepers’ Hole for a dock? I am not.

216. You also propose to obtain the sluicing power by water penned up on the opposite side to Sleepers’ Hole, near the entrance of the harbour?—Yes.

217. You recommend groynes on each side of the harbour to give a wider first entrance as you call it?—Yes.

218. To what extent are those groynes to go?—500 feet.

219. What distance are the piers to be apart from each other in widening the mouth of the harbour?—About 400 feet.

220. With a flood-tide running in and a fresh gale, would not the piers and the space between them and the proposed groynes occasion a violent rebound of the sea, and render the inner entrance dangerous?—I should say not; I think that would act like a bell mouth; my observations while I was on the spot went to the extent, that if anything of the kind was adopted you would get smooth water.

221. The question supposes the wind to be blowing right in, the sea and the wind going in?—I do not think that would make any difference; but that it would be a great advantage that the sea should be broken.

222. Is it to be understood that the pontoon you propose should fill up the passage of the harbour, the water of the harbour being made to act as a sluice, instead of running out in the ordinary course?—Occasionally when the weather will suit, I should wish to place the pontoon in any convenient part of the harbour within the pier heads. I take a pontoon of 106 feet long, that is about the length of an ordinary sized gun-brig.

223. That is the breadth of the harbour?—Yes; all the way up and down the harbour, there are piles for vessels to lie at, there are many places where they might be made wider than the entrance of the harbour; occasionally they might be made solid, which are boarded up; then the pontoon placed between such piles and the opposite side would act in displacing the water, as I can show upon the model.

224. You say in your paper that the pontoon is to be laid across the harbour after the trade has come in on the flood-tide?—Yes.

225. What are the vessels to do when they wish to pass out on the ebb-tide?—It has not been usual for them to pass out on the ebb-tide. I do not know that I have ever seen a vessel go out after the last quarter-flood. I have been in the habit of sending our tenders in and out, but have never attempted it except in the flood-tide.

226. At what time do they come in?—They come in during the last quarter-flood, there is 13 feet on the bar at half-flood.

227. You say it is within your power to deepen the entrance of the harbour, and that Captain Bullock bored 17 feet at the harbour’s mouth into blue clay?—Yes; precisely.

228. (*Lt.-Col. Alderson.*) And that you can accomplish it by means of an auger?—Yes; I have a model here.

229. Will you explain the mode of using this auger, and the quantity of mud or sand it would bring up at one bore?—I at first thought that six feet would be the best diameter for the auger, but I think that four feet would, upon the whole, be best. Eight men with a capstain-purchase with a screw could bore to any extent even to the 17 feet if necessary. With the returning power of the screw the whole of the soil would be brought up into a guard, the centre of the auger being on a pivot and the soil being deposited alternately on each side of the barge. Of course the greater the depth required the less the diameter of the auger would be that would be used. I have two kinds of augers, one for boring into hard soil and the other into clay, either instrument being more suitable than the common dredge for going down into the original clay or hard bottom.



230. How long will it take to bore 10 feet?—I should say a quarter of an hour; I propose allowing the lighter to ground, if possible, in that case she would always clear her length every tide. I propose that every tide, night and day, she should clear her length.

231. (*Mr. Walker.*) What quantity would you bring up at one time with your auger?—I should say a ton each time at least.

232. Have you ever entered into any calculation of the expense of building a vessel and providing the necessary machinery for this purpose?—No; I have not gone to that extent. I did not think the matter had advanced sufficiently to go into that; I should think it would not be expensive.

233. How many men would you require to perform the work in the harbour?—Eight men; that is the whole number I should recommend. If a steam apparatus should be applied, of course it would go on much quicker, and that would be more advisable in consequence of the power of availing ourselves of fine weather, to work outside.

234. As you recommended deepening to the extent of six feet, but now only four, have you ever calculated how long it would take to deepen a space of any given extent, say fifty yards between your proposed groins?—I have not, for that would depend altogether upon the state of the weather. If it blew hard and fresh, they could not work outside; but I propose in blowing weather to work inside, and in fine weather and outside.

235. (*Lt.-Col. Colquhoun.*) Have you ever made a calculation of the whole expense of raising and relanding the soil?—No; I have not had time to make that calculation.

236. As the operation of boring would necessarily be a slow process, would there not be danger of one hole filling up again before another was finished?—No; I think that the primitive soil being bored, the discharge of water from the harbour would prevent any accumulation taking place.

237. The water can be deepened throughout the whole fair-way, and the approach to the harbour would be improved by deepening the immediate mouth of the harbour?—I should propose to begin at the outside, and I should deepen the fair-way also.

238. (*Sir Howard Douglas.*) You think you could make improved approaches at an earlier period of the flood-tide by this process?—Certainly; I should think at least two hours.

239. Would your proposed operations be confined to the outside of this caisson or floating-gate you propose?—The floating-gate is to be confined within the entrance.

240. What do you propose to do with the floating-gate afterwards?—I can shift the floating-gate to any part; I can shift it to the upper part, if required, where there are piles fitted.

241. How far up do you propose extending your deepening?—As far as is necessary for shelter or for commerce; indeed the commerce can be only for the supply of the neighbourhood, which is in fact Lewes; but as the necessity was felt, we should use the boring or the sluices higher up.

242. Your sluicing would all be between the pontoon and the sea, or would you fix it higher up?—As I proceeded, I would carry it up.

243. Then you must carry up the pier-heads?—No; that would not be necessary. Between the river wall and the piles on the opposite side on which the shipping lie, a pile might be planked round, in lieu of remaining open, then the pontoon should be placed between the piles and the river wall.

244. Narrowed?—Yes; and that it should be discharged at any one place that practice showed to be best suited.

245. You would have occasional narrowing in width in certain places?—Yes; there are those places now.

246. Do you expect that the sluicing, caused by the operation of the pontoon, should deepen the wide places that will exist between the contracted places?—Yes; where that could not be accomplished, the boring-machine would accomplish it: those piles are already there.

247. (*Admiral Dundas.*) Do you consider that by all the improvements you suggest, New-haven could be made a harbour easy of access at all times of the tide to vessels requiring shelter from stress of weather?—I think it could be made a harbour easy of access between the outer piers.

248. Could it be made easy of access at all times of the tide to vessels requiring shelter from stress of weather?—Yes; I think so.

249. Vessels of what depth?—I should say that, by boring and by sluicing into the primitive soil, the blue clay, the only obstacle would be the shingle on the mud, which would be displaced by the sluices.

250. Do you mean at all times of the tide?—Yes; I should decidedly say so, by extending the piers,—of course they must be extended.

251. You think that after that the harbour would be accessible at all times of the tide?—Yes; I think it would be capable of access, decidedly.

252. At what draught of water?—For the large class of steamers, 15 feet at low water.

253. How far would you carry out your pier?—I would carry out the pier 1000 feet, allowing one portion of it to go 200 feet within the other.

254. What soundings are there 1000 feet from the shore?—I think there is about five fathom.

255. What bottom is there?—The blue clay; of course it would require heavy piles for the piers.

256. How does the harbour mouth run?—I think it runs about N.N.W.

257. Do you mean that steamers of large size would be able to take shelter under this sort of projection, or that they might actually enter the harbour?—Enter the harbour if the harbour is capable of access, which it would be if it was made deeper, and the entrance improved.

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258. What is the occasion at present of vessels not being able to get in or out until the last quarter of the flood?—Because the piers are not extended enough, and the channel has not been deepened.

259. The piers will remain the same as they are, only that you will make another set of piers outside?—Yes; expanding.

260. Therefore the same inconvenience must remain as to the tide?—I think not; it is not the narrowness, it is the depth. If you increase the depth between the piers, the vessels will be able to get in as well between the narrow as the wide piers.

261. You say that no vessel can come out on the ebb-tide; what is the reason of that?—That is in consequence of the immense run of the tide over a shallow bottom.

262. And the narrowness of the channel, which makes the force the greater?—Yes.

263. Do you know at what rate it ebbs out of the harbour?—I think about five or six knots, depending on the quantity of water, and whether the low lands above are flooded from rains or not.

264. (*Captain Fisher.*) By the plan you propose, and the model which you have brought for the consideration of the Commissioners, which you state to be with a view of making Newhaven accessible at all times of the tide, what would be the least depth of water at the lowest spring-tides?—I should say 13 feet.

265. Does your plan for the improvement of Newhaven Harbour, which you bring forward for the consideration of the Commissioners, and the model, go to the extent of making it accessible to all ships at all times of the tide?—Yes; I do not mean line-of-battle ships or frigates, I mean powerful steamers and merchant-ships.

266. What depth of water should you be able to ensure such vessels if induced to enter at the lowest tides?—I should not say that a vessel drawing more than 13 feet will be able to enter at low water.

267. You mean that a vessel would be sure to find 13 feet at the lowest spring-tides?—Yes.

268. What is the width of the harbour mouth at present?—106 feet.

269. What should you propose to add?—I should add 250 feet to that, and I should carry the eastern pier further to the eastward.

270. The plan you bring forward, and which you propose illustrating by your model, you conceive goes to the extent of admitting all ships at all times of the tide?—Yes, it does.

271. Ships of moderate draught of water?—Ships drawing 13 feet.

272. You were understood in your first answer to state that vessels could not come in at all times of the tide, but that you should make it accessible two hours earlier?—I conceive it would be accessible at all times of the tide for vessels of that draught. I would beg to state that there is an immense back-water, which renders Newhaven capable of being made into anything that may be required.

273. (*Captain Washington.*) Supposing a vessel to run for Newhaven in a south-west gale, and owing to a sudden fog or any other cause she should miss it, could she haul off the shore?—I would answer that question by stating, “that I have known one of our tenders to make an offing when she had been embayed by a sudden gale; I will give the instance: the “*Highflyer*,” commanded then by the present Commander Pearce, when a mate of the “*Hyperion*,” came off the harbour deeply loaded with provisions, and the best part of it on deck. I sent out the boats to bring in the provisions; but the boats were lost: the vessel was saved by making an offing in a heavy gale of wind; it came on to blow tremendously heavy; the boats put ashore off Bear’s Hyde; I got the provisions ashore there, but lost the boats: we had been obliged to wait for the tide to send out the boats; we could not send them out with the ebb-tide, and I waited till it was high water. While they were taking in the provisions, Mr. Pearce felt that it was necessary to make an offing; he cast off the boats, and made an offing by weathering Beachy Head.

274. (*Admiral Dundas.*) Here the gale came on while the vessel was unloading; but put the case, that a gale of wind had been blowing two days before?—During the five years and odd I was there I only knew of one vessel being wrecked behind the piers at Newhaven.

275. Have many vessels run for that?—A great many used to come in for shelter.

276. Did you never know of more than one vessel being lost between Newhaven and Beachy Head?—A great many have been lost between Newhaven and Beachy Head; but I am speaking of Newhaven itself.

277. The vessel you refer to had run for a port in a heavy gale?—Yes.

278. Suppose a vessel at sea, and she sees that dirty weather is coming on, and she wants shelter, would she rather have a breakwater harbour east or west of Beachy Head?—My preference is in favour of another harbour immediately to the westward of Beachy Head, which is Cuckmere; it might be that she could not get round the Head; there are many instances of vessels having been embayed there, and lost.

279. On which side of Beachy Head would a vessel, under such circumstances, prefer to have a breakwater?—I should say decidedly to the eastward; but I do not know how, in many instances, they could get at it.

280. If you were asked, as a sailor, to which side of Beachy Head you would run in a gale of wind, with the wind S.S.W., what should you say?—I should decidedly keep to windward, and go round the Head if I could.

281. (*Sir W. Symonds.*) With that sort of weather coming on, on which side of Beachy Head would you, as a sailor, wish for a breakwater to run for, one on the east or one on the west?—That requires very great consideration; it is not at all connected with that which I proposed; it might happen that vessels coming up Channe might get embayed in Seaford



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Bay, and might not be able to get round Beachy Head at all; my plans provide for shelter to the westward, not a breakwater.

282. Supposing you were bound down Channel with a fair wind, with an easterly gale, and ten leagues west of Beachy Head, the wind came round from the southward to the south-west, and blew hard, and night was coming on, where would you, under such circumstances, be glad to find a harbour of shelter constructed, to the east or the west of Beachy Head?—I really never gave a thought to a harbour to the east of Beachy Head, seeing the difficulties of constructing one.

283. Supposing a harbour of refuge to be provided, a breakwater harbour on one side or other of Beachy Head, which would you prefer?—For a breakwater harbour, I should say to the eastward of Beachy Head.

284. (*Chairman.*) You have a plan also for giving a more straight direction to the entrance of Cuckmere Haven?—Yes; and deepening it also within.

285. Is there any river or stream within Cuckmere that might be made available as a back-water?—There is a very powerful stream runs over the Haven at present; what I should propose is, to reserve the spring-tides at high water within a pontoon.

286. Has this proposal any connexion with your plan for improving Newhaven?—For the reasons I have given in the paper I have laid before the Commissioners, I conceive both Cuckmere and Newhaven would be very important, as ports of refuge, for vessels that could not round the Head.

287. Then you propose to improve these ports?—Yes, and that they would be essential for steamers-of-war, and for the protection of the Channel trade in case of a war, when cruizers would be obliged to bear up under strong S.W. gales.

288. What you propose for Cuckmere is the running out of two piers?—Yes, and the deepening within; it must be deepened within considerably.

289. In what direction would the piers point?—Nearly north and south.

290. It would be open to the south gales?—Yes, open to the south wind.

291. Fronting in that direction, would not the harbour be liable to the incursion of sand and shingle?—I think not; the pent-up water would prevent that after boring down into the original clay for a channel, the reserve of water when let loose from the pontoon would carry out the sand to seaward, and its ordinary drift to the eastward would carry it away from the harbour mouth towards Beachy Head.

292. Your suggestion does not go to any improvement at Seaford?—No, I have not taken that at all into my view.

293. You think that Cuckmere is a more eligible place to deal with?—I do.

294. Is there anything more you would wish to state to the Commissioners?—I am not aware of anything more than what is embodied in my papers.

295. You have stated only concisely what is embodied in your papers?—Yes, so far as I have been questioned; I should wish to explain my hydraulic models, which I have nearly ready in a room outside.

296. Your plan of improvement of Cuckmere goes to the extent of making it a harbour of refuge?—Yes, precisely so, accessible at all times.

297. To what extent of draught?—To the extent of 13 feet, for it is as capable of being made as good a port as Newhaven.

298. (*Sir Howard Douglas.*) How far does the depth of water outside Cuckmere afford facility of access?—The water is much deeper outside of Cuckmere than Newhaven; the sand does not extend more than 50 feet from the river mouth, I think.

299. You speak of there being a back-water, where is that?—There is a mill a great distance off, at the head of it.

300. Is it a stream capable of being turned to any account?—Yes, there is a great deal of water rolls over the shingle at times.

301. There is an embankment and a dam across it?—Yes; at the mill.

302. And a mill which uses the water above?—Yes.

303. You would not take any measures to deprive the mill-owner of the water?—No, I think there would be quite sufficient after boring into the primitive soil lower down.

304. What number of vessels do you suppose that Cuckmere would receive if your improvements were carried out?—I should say fifty.

305. Vessels of what size?—Fifty vessels of 500 tons.

306. The improvements you proposed are, constructing two piers and clearing out the harbour?—Yes, deepening the haven.

307. (*Mr. Walker.*) Have you ever tried boring?—Only in the model, but I am convinced of its feasibility.

308. To what distance do you propose to carry your piers at Cuckmere?—500 feet.

309. You have not entered into any estimate of the expense of carrying out the piers?—No, on the boring principle it would be less expensive than in any other mode of excavating.

310. What are the piers to consist of?—The same as Newhaven pier, or piles filled up with chalk. I should make them as solid as they could be made with wood.

311. (*Admiral Dundas.*) Supposing you were in a hard gale of wind blowing strong, and Newhaven were improved with an enlarged entrance, and there was also a breakwater to the east of Beachy Head, and you had it in your power to run either for Newhaven Harbour or the breakwater east of Beachy Head, which should you go for?—If I had it in my power to run for Beachy Head, and were going up Channel, decidedly I should run for Beachy Head if there was a breakwater there; but the accomplishment of the breakwater which has been long talked of, appears very doubtful in my opinion.



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312. Supposing you were in a gale of wind being bound down Channel, with a south-west wind, and that you had on the one hand Newhaven Harbour to run for, with a narrow entrance, and on the other a harbour under Beachy Head, which should you run for for safety?—My bias is in favour of Newhaven. I would run for Newhaven, for I would get as far to westward as I could.

313. Laying aside all bias, and speaking as a sailor, which should you go for?—Beachy Head breakwater when it is done; I should have this advantage, that I could get in and out at all times if they make it as it is proposed; but many vessels could not run there; there are instances of vessels being wrecked that could neither reach Newhaven nor round Beachy Head. (*The Witness produced his model of Cuckmere Haven, and pointed out the parts in which he proposed to make improvements.*)

314. (*Chairman.*) How far does the tide go up?—About three miles.

315. What depth of water do you propose to provide and render certain at low water?—Thirteen feet.

316. What extent of excavation should you have to make altogether?—I dare say 150 acres.

317. How far is Newhaven Head from the mouth of this haven?—Nine miles.

318. (*Mr. Walker.*) Can you make any estimate of the expense of accomplishing that which you propose?—I should think 20,000*l.* would effect it. I conceive the whole would be done by boring and by the back-water. I should bore with augers of 4 feet diameter.

319. How would you retain the banks if you bored the bottom away?—There are chalk hills, and the ground rises on each side the haven.

320. You say you have made no estimate of the expense of excavating these 150 acres so as to produce depth to the extent of 13 feet?—My opinion is that 20,000*l.* would make it accessible to vessels of 13 feet draught; if it were thought desirable to carry it further, that might be afterwards done.

321. The expense of effecting it, and the subsequent annual expense, must be borne by the Government?—Certainly, there are no other means. (*The Witness produced his model of the boring-machine proposed to be used, and exhibited, by working it, the mode of its operation, and its effect.*)

322. Do you propose to take away all the mud, or to make holes and let the backwater perform the rest?—I should not make them nearer than was necessary for the backwater to carry off the remainder, which it would do to a certain extent. (*The Witness produced his model of Newhaven Harbour, and pointed out the parts in which he proposed to make improvements.*)

323. (*Chairman.*) What is the eddy of Seaford Bay as it respects this harbour?—All I know is, that the shingle continues its course to the eastward.

324. Did you ever hear that Seaford Bay was sanding up?—Yes; I think that is very probable.

325. You propose, after you have bored, to keep the harbour open by sluicing?—Yes.

326. You propose to keep it 13 feet deep at low water at the width of 400 feet?—Yes; the sluicing would act on the deep holes made by the boring.

327. Have you made an estimate of the expense of this?—It appears to me, that if 15,000*l.* were laid out for three years, both might be effected, so as to see the working of the plan.

328. Making the expense 45,000*l.*?—Yes, for the two.

[*The Witness withdrew.*—Adjourned to to-morrow, at 12 o'clock.

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Wednesday, 8th May, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Mr. Rich. Stuart.  
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Mr. Richard Stuart, examined.

329. (*Chairman.*) In what capacity do you serve, and where?—I am a Queen's pilot, at Woolwich.

330. A pilot to what extent; what are your waters?—I have been generally cruising in men-of-war, in all parts of the Channel and the North Sea.

331. From one extremity of the Channel to the other?—Yes, to the Land's End.

332. You have been also a North Sea pilot?—Yes, I have been a great deal in the North Sea.

333. Have you an intimate knowledge of the harbour of Dover?—Yes.

334. Do you frequently go into it?—Yes.

335. Have you ever considered the plan for enclosing the Bay of Dover with a break-water, and converting it into a harbour?—I have heard of it; I have not considered it much in my own ideas.

336. Should you consider it a desirable position for the trade of the country to have a harbour?—It would be a very good position, certainly.

337. Do you mean Dover Roads or Dover Harbour?—Dover Roads.

338. What do you know of Dungeness as an anchorage?—It is a very good anchorage; with a wind from the south-west, you can ride in the bay; and in the West Bay you can ride with a wind at east-and-by-south—that is, coming along the land.

339. Is there a large scope of good anchorage there?—Yes, there is plenty of scope there.

340. What should you think of a breakwater there?—I do not know; that requires a



great deal of consideration. About making a breakwater there, it is not made altogether to secure the ship; but we must have a breakwater that the ship can get out of, as well as in—we must not tie her up.

341. Suppose a harbour constructed there, how would it work?—There is a long flat there; there is so much sand on both sides of the Ness.

342. You think there might be objections to having a breakwater or harbour there?—Yes; I do not think that it would answer.

343. Have you been much about Beachy Head?—Yes.

344. Supposing a harbour were to be constructed there, on which side of Beachy Head would you prefer it?—It has been a long time in my head that Newhaven would make the best harbour; that is the only place I can see where you can make a harbour.

345. When we speak of a harbour, we mean one accessible to ships of war as well as merchant-ships, at all times of tide?—Yes, just so; I think that should be provided for.

346. By what means do you suppose that could be effected at Newhaven Harbour?—By a pier to the westward, and a pier running out of the bay to the eastward from Seaford; the vessels would be sheltered from the heaviest of the sea, with the wind at south-east.

347. Have you ever been embayed on the coast between Beachy Head and Seaford?—Yes, but not but that I could get out and make an offing.

348. How would a merchant-ship do in such a case?—A merchant-ship would not get off if it blew hard from the southward.

349. To what extent must the piers be carried out to make a harbour at Newhaven?—You may carry them to any length you like; it is a regular flat all the way to Littlehampton; you may turn into what water you please. I suppose they will go out about south-south-east. I should propose a pier to the westward from Burrow Head; or it might be even further to the west than that.

350. You would propose it from the Fricker Rocks, perhaps?—Yes.

351. To what extent—600 yards?—It might go further than that.

352. The point shown you on the plan is 1000 yards; do you think that would make it accessible at all times?—Yes.

353. You have no doubt that running a pier out to the extent of 1000 yards would make the harbour accessible at all times of the tide?—I think so: what I mean to say is, that I would make a harbour of this bay; I should propose to make this bay into a harbour.

354. Can you make it into a harbour without some covering to the entrance?—There must be a pier at the eastward, as well to protect it from the east part of the bay.

355. From what part?—That depends upon the distance at which you place the piers—perhaps about Seaford; then it need not come so far out, because the water is deeper. I should propose to take in the bay. On examining the plan, I see it must not come to Seaford Head; it must be opposite to the church and mill.

356. From Seaford Church and Mill you would bring out the point in what direction?—It would come out into about 6 or 7 fathoms water.

357. Then there would be an open place along the sea-shore?—If it is felt that the space is too large, taking it from opposite the church, it can be shortened.

358. (*Admiral Dundas.*) If you had the choice of a refuge harbour at Beachy Head, on which side of the Head should you prefer it?—I would have it on the east side.

359. In Eastbourne Bay?—Yes.

360. What would you fix on as the point?—Somewhere about Eastbourne.

361. Have you ever been at an anchor there yourself?—No; but I have been cruising many times there in a 10-gun brig.

362. Does the shingle move much along the coast?—No, I do not think it does, for it is mostly chalky; the rocks are chalk rocks.

363. There is a shoal called Holywell Bank; do you think that would form any objection to constructing a breakwater in Pevensey Bay?—No.

364. You would prefer a harbour off Eastbourne to having anything done at Newhaven?—I think I should, as a harbour of refuge.

365. Supposing you were five or six leagues to the westward of Beachy Head, and were going down Channel, and the weather looked dirty, with a south-west gale coming on, and there were piers thrown out at Newhaven, and a breakwater in Pevensey Bay, which should you run for?—I should run for the breakwater of course; to make a pier harbour is difficult for a ship: sometimes you cannot do it. If the harbour were made in the way that I have been speaking of, it would be quite a different thing.

366. The question supposes the harbour made as you would propose at Newhaven; that would be open to the south?—Yes.

367. The breakwater at Pevensey Bay would be shut up from the south-west?—Yes.

368. Nine months in the year the wind blows from the south-west?—Yes.

369. Would there not be better shelter in Pevensey Bay than any you could procure at Newhaven?—Yes, that seems to be so.

370. (*Chairman.*) There is a place called Foreness; do you know that?—Yes.

371. Is there any place you would recommend there as a harbour of refuge?—No.

372. You know the Brake Sand?—Yes.

373. Is that a good place for a harbour?—You must consider the water there three fathoms and three and a half; but as to the Brake itself, if there is water enough inside for small ships, there would not be enough for a line-of-battle ship.

374. Did you ever hear of the Brake Sand shifting?—Yes, always; ever since I knew it.

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375. Is it possible to construct a breakwater at the Goodwin Sand?—The Goodwin shifts as much as any other sand.

376. Would Dungeness, in your opinion, be a good place for a harbour of refuge?—No.

377. (*Admiral Dundas.*) What, in your opinion, is the best place for a harbour of refuge for every description of vessel between the mouth of the Thames and Beachy Head?—I should think under the Head, off Newhaven.

378. Looking along that side of the coast, taking Dungeness, Folkestone, Dover, Ramsgate, Margate, the Brake, the Goodwin, and Foreness, in which place of all those would you recommend a harbour of refuge to serve for all purposes?—I think to the westward of the Head.

379. Which, in your opinion, from Dungeness to the mouth of the Thames would be the most proper place for a harbour of refuge for steam-boats and vessels of all descriptions at all times of the tide; should you say Folkestone or Dover Bay, or what spot?—I hardly know where to say.

380. What is the most central spot?—It would not do round the North Foreland, for if the wind set in easterly, a ship could not get out.

381. The question includes all from the west of the North Foreland to Dungeness; where would you put a harbour of refuge if you had only one to provide for; in Dover Bay or Folkestone Bay, or Trinity Bay, or where, taking into view the occurrence of a war, and the necessity of protection to steamers and the collecting of convoys?—It must be about the Downs at that rate.

382. Why not to the westward of the Downs?—Somewhere to the westward of the Downs; I do not see any other place but Dover Bay; I think that is the only place.

383. You consider Dover Bay as, upon the whole, the best place looking along the coast from the river Thames to Dungeness?—Yes, I think so.

384. How long have you been a pilot?—25 years.

385. Did you ever command a vessel navigating in those parts?—Yes, in both the English and the Irish Channel.

386. You therefore have had an opportunity of knowing the Channel well, and what parts of the coast are the most eligible for such a construction?—Yes.

387. Your father was a pilot before you, was not he?—He was.

388. (*Sir Howard Douglas.*) Suppose there were a harbour of refuge constructed in Dover Bay, knowing as you do how Dover Harbour now fills up with shingle, would you leave the opening close to the shore or run your pier out into deep water?—You must run it out into deep water, or you could not keep it clear.

389. Would an entrance at the south-west be the best?—You must not have it too much to the westward, or the ships could not get out.

390. The central opening will face the south?—Yes, I should think so.

391. Would it be necessary to have two entrances, one to the eastward and another to the southward?—Yes, that might be so; I do not see why it should not.

392. Look at the map before you, you will see openings marked A., B., and C., do you approve of all those openings or not?—I should say two would be sufficient.

393. Which of the three would you shut?—The southern, C.; I should have only one to the eastward, and one to the westward.

394. Do not you think that, with the western opening of A., the shingle would pass through?—I do not think it would if it came out into five or six fathom water.

395. Would there not be less chance of the shingle passing into the harbour if A. were shut up and C. were left open?—I think it might be more apt to pass into A.

396. Supposing a ship coming up Channel, the wind blowing hard to the westward, the entrance at C. would be convenient and easy for her entrance?—Yes, but you must not say too much about the ease of it; the tide would be very strong across the piers.

397. Would it be necessary she should have a pilot?—No, she would not require a pilot; it is only entering between the two piers, and if they cannot keep clear of the piers, it is their own fault.

398. What distance should you propose between the pier heads?—I think about 700 or 800 feet; I think that would be required for the ship to work out.

399. What is your opinion of B. to the eastward?—She could go out there of course.

400. If the wind came round, she could go out at B.?—Yes, certainly.

401. Upon the whole, which do you consider the two best approaches to that harbour, supposing only two were made, whether A., B., or C.?—I would take C. southern for one and B. eastern for the other.

402. Why do you require a space of 800 for the opening?—I do not think that it need be so wide if there are two openings.

403. Tug-vessels might be had if necessary?—Yes; I think 400 feet would be quite enough.

404. 400 feet for the large opening?—Yes.

405. (*Captain Fisher.*) You have stated that you have been in the habit of taking vessels as a pilot from the river Thames; how far have you gone?—To the Land's End.

406. How long have you been employed in performing that duty?—Twenty-four years.

407. What is your opinion, supposing only one harbour of refuge were to be provided, as to the best position between the Downs and Portsmouth for that harbour of refuge, bearing in mind that it should be accessible at all times of the tide for ships of-war as well merchant-men?—The bay east of Beachy Head will not do for a line-of-battle ship; in my opinion it must be in Seaford Bay.



408. Have the goodness to state your reasons for giving the preference to Seaford Bay? —My reasons are on account of the water required for line-of-battle ships.

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409. Which of the situations, supposing a harbour to be constructed to the east of Beachy Head, between Margate and Foreness, within the Brake Sand, Dover Bay, Dungeness Bay, Eastbourne or Pevensey Bay, would you prefer, taking into account both coming and going, and all ships that might require to use it?—For line-of-battle ships it must be on the west of Beachy Head; I should say Seaford Bay.

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410. Seaford Bay in preference to any of the other of the situations?—Yes.

411. Having stated that Seaford Bay would be the best place in your opinion as a pilot for ships, some homeward bound, and others outward bound, finding themselves in a situation requiring shelter, would there not be great risk of their getting embayed by running for a harbour made at Newhaven?—No, I should think not, for no persons would attempt to run unless they could get into that harbour.

412. Have you not been in situations in which you could have found refuge if a harbour had been constructed, either under Dungeness, or in Dover Bay, when you might have been prevented running for Newhaven?—No, I think not; I cannot see any place to equal it.

413. Supposing yourself a pilot in the Admiral's ship, with ten sail of the line, the wind blowing hard on shore, would you advise the running down on the lee-shore into this port, especially if the weather were at all thick?—Yes; but I should not attempt to run for it if the weather was thick.

414. If it came on thick, would you not get embayed there?—Then I should haul off again.

415. As a pilot of long experience, which the Commissioners understand you are, do you suppose there would not be much greater risk with a strong westerly wind in running for a harbour of refuge in Seaford Bay than for a harbour of refuge in Dover Bay?—I think not; I think Seaford Bay would be the best; I speak as to the ship getting to sea as well as getting in, with easterly or westerly winds.

416. You think, taking into consideration all circumstances, that Seaford Bay is to be preferred?—Yes.

417. (*Chairman.*) If a breakwater were constructed in Seaford Bay, would it be a great advantage to the harbour of Newhaven?—I should think it would be a very great advantage.

418. Would it make Newhaven available at times when it is not available at present?—Decidedly.

419. Would it also be an advantage to Cuckmere?—No, I do not think it would be of any advantage to Cuckmere: Cuckmere grows up completely in time; there is scarcely any opening at all.

420. You think that if there was a breakwater in that situation, there would be an advantage in the breakwater having Newhaven inside it, and that the breakwater itself would be an advantage to Newhaven, that there would be a mutual advantage?—I think so.

421. (*Sir W. Symonds.*) Supposing you were acting as pilot of a ship, and that you could not fetch into a harbour of refuge at Seaford, you must of course go higher up for refuge?—Yes.

422. Where should you take refuge higher up, provided a large breakwater a mile and a half long, and carried to any extent that might be considered desirable, were erected, where is the place where you would take shelter in ground where you could anchor without driving?—You might make a breakwater at Dungeness in the East Bay.

423. Is the holding-ground good in the East Bay?—Yes, very good.

424. Of what does it consist?—It is blue clay and sand, forming good holding-ground.

425. As good as the Downs?—Yes, better.

426. You say that the point would shelter you from the south-west winds?—Yes, there you will be in about three fathoms and a quarter water, the light bearing south-west.

427. You would recommend a breakwater to be formed to give you shelter from the south-west round southerly to the bearing of the Foreland, so as to bring in the northern end of the breakwater?—No, it must not go only to the direction of the Foreland, for that would be east-north-east; it must go more to the north-eastward.

428. What is the nature of the ground for anchoring in Dover Bay?—It is sand and chalk.

429. Along the line of the breakwater you saw on the plan just now, is the whole sand and chalk?—No, shingle as well in shore.

430. Is that good holding-ground, as good as that of Dungeness?—No, nor yet as the Downs.

431. You were understood to say that Dover is not so good as Dungeness or the Downs?—Neither Dover nor the Downs are so good as Dungeness; but I have been riding with a ten-gun brig in Dungeness Bay, and have been obliged to slip.

432. If Dover Bay were enclosed with the large breakwater which you saw on the plan, and you entered it in a large ship, should you feel confidence in the anchor holding when there was a heavy gale of wind blowing, considering the contracted space within that harbour, and do you think a large ship, a line-of-battle ship, anchored immediately on entering the pier heads, would have room to bring up, a great many vessels having taken refuge there besides?—She might bring up; but the query is whether she would not strike.

433. (*Chairman.*) Would she drive up hill?—Yes, she would drive up hill.



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434. Is there any difficulty in bringing up a ship in that anchorage supposing you carried out in 7 fathom water?—There is no difficulty in bringing up the ship; but when it blows hard, I do not think a line-of-battle ship would ever take it.

435. What is the objection?—If it blows a gale of wind, and I let go my second anchor, I cannot give her any cable.

436. Supposing a breakwater to be made at Dungeness, would not the same difficulty exist as to the space for bringing a ship up?—I am of opinion that a line-of-battle ship never would enter there.

437. Suppose you were coming up in a gale of wind, with the wind at W.S.W., would you take a harbour of refuge there, or go for the Downs?—I should go for the Downs; the place is too narrow for a line-of-battle ship.

438. Some of the questions have put an extreme case to you with respect to a line-of-battle ship; suppose the harbour to be only for frigates and for squadrons of steamers, should you see any objection to it in that point of view?—Oh, no; not at all.

439. Were you ever upon the Royal Sovereign Shoal?—Yes; I have been over it many times, not touching it with the ship.

440. What sized shoal is that?—Really I cannot say; but I think there is more water upon it than is generally supposed.

441. What number of feet at low water?—I think there is not less than 16 feet.

442. What is the extent of that shoal?—I suppose about a quarter of a mile or half a mile.

443. Do you think it is chalk or sand?—I think it is chalk.

444. What is the distance from the Sovereign Shoal to Beachy Head?—About five miles and a half to six miles.

445. Supposing there were a harbour of refuge to the east, or under Beachy Head, do not you think a ship could get shelter at any time of the night or day?—Yes; but I am not putting the case of a line-of-battle ship; it is a very narrow place; there is a great deal of foul ground within side of the bay.

446. Of what nature?—There are a great many chalk rocks in the inside to the eastward of the Head.

447. Do you mean in Pevensey Bay?—No; to the northward and eastward of the shoal.

448. The Ratton and other shoals?—Yes.

449. (*Admiral Dundas.*) Supposing you were a pilot of a ship in a hard gale of wind, and you wanted to bear up for refuge, the wind being at south-west, that you had a breakwater off Seaford which is to leeward, and another off the Head which is sheltered from the south-west gales, which should you prefer to run for?—If I was bound down Channel, I should go to the westward; to Seaford, certainly.

450. What holding-ground is there at Seaford?—The ground is very good holding-ground.

451. What sort of ground is there in Eastbourne Bay?—I never was riding off Eastbourne.

452. There is plenty of room inside at Eastbourne?—Yes, for a 10-gun brig.

453. (*Captain Fisher*) Supposing you were running up Channel, being to leeward of Beachy Head, even if a breakwater were formed either to the eastward or the westward of Beachy Head, and you had to bear up, having said that you would anchor at Dungeness, with the wind at south-west, and that there is good holding-ground there, should you in that case anchor at Dungeness, with the chance of having to slip and run into the Downs if the wind came further round to the southward; or would you, in the event of there being a harbour formed at Dover, run for it, in a large frigate or a large steam-vessel-of-war, a great many vessels, probably 100, having taken shelter there?—I think I should take Dungeness.

454. The question supposes there was not a breakwater at Dungeness, but that there was one at Dover?—Then I should go on to the new harbour of Dover.

455. You would do so in a large steamer or frigate?—Yes.

456. (*Captain Washington.*) For vessels coming from the North Sea, and bound to London, or to the westward that do not come through the Swin, where would be the most useful harbour of refuge?—They must come into the Channel.

457. Do not many ships coming from the Baltic make the land at the North Foreland?—Yes, but not if they are bound down Channel, unless they are blown across; it is only the vessels from Holland or Antwerp or those places that make the Foreland; but the Baltic ships, or those from the northward, unless they are blown away, never come across the Kent.

458. Where do they make the land?—They generally make the land at Lowestoft; very often at Flamborough Head.

459. Would a harbour of refuge, enclosing Margate Roads from Foreness, be of great use to shipping generally?—I cannot see that it would myself; they might as well extend Margate Harbour, and make that a harbour of refuge.

460. Would that be of any very great use to the trade of London?—I cannot see that it would, with the wind easterly.

461. Do not ships that break away from their anchors in the Downs often seek shelter in Margate Roads?—Yes.

462. Supposing the wind to come from the eastward, are they not exposed to the whole of it?—Yes; they are.

463. Still you do not consider a harbour there necessary?—No; I do not.



464. Is the anchorage between Margate and Margate Sand good holding-ground generally?—It is hard ground, chalky ground. Mr. Rich. Stuart.

465. You say you have known the Brake as a shifting sand, have the buoys been shifted often within your memory?—Yes. 8th May, 1844.

466. How long have you known the Brake to be a shifting sand, ten or twelve years?—Yes; longer than that.

467. Is it moving any particular way?—I can scarcely say which way it is moving, unless I were always looking after it. I see it is moving by the broken water in crossing it.

468. (*Chairman.*) It appears from Captain Bullock's survey that the Brake Sand has moved 700 yards to the westward, its whole length; were you, as a pilot, aware of that?—Yes.

469. What time has that change taken in effecting?—It has been altering a very long time, these 14 or 15 years to my knowledge.

470. You have known it that time?—I have known it these 30 years.

471. How often have you known the south buoy to be shifted?—I do not think the south buoy has been shifted, it is the middle buoy; you can go with a frigate between the south buoy and the shoal; I have crossed it with a frigate.

472. (*Sir H. Pelly.*) What is the depth of water at low-water spring-tides within the Brake?—I think there is about 3 fathoms or  $2\frac{1}{2}$  at the upper end.

473. What will be the depth of the water in the middle of the anchorage?—About five fathoms, to the southward.

474. Where would be 18 to 21 feet?—Towards Ramsgate, to the northward; to the southward the water deepens.

475. Do you think there would be any difficulty in constructing a harbour of refuge enclosing the Little Downs within the Brake?—I cannot answer that question.

476. Do you think there would be sufficient anchorage, supposing a harbour constructed there, for 100 sail?—I think not, unless you take in the whole of the Brake.

477. (*Captain Washington.*) Looking at the proposed breakwater in Dover Bay, if made with only one entrance, are you of opinion that there would be any difficulty in ships such as the "Vernon" and the "Medea," and the heaviest merchant-ships getting in there or working out at any time, the entrance being 800 feet wide?—I do not see that there would.

478. (*Chairman.*) Supposing the wind at west, and the vessel anchored near the eastern end, and a good many vessels lying at anchor?—They would not turn; there would not be sufficient room for them to turn.

479. Perhaps you think there should be two entrances?—No, I do not.

480. Do you think ships would not ride there in safety with half a cable out in a heavy gale of wind; would they require more than half a cable to ride in safety?—Yes; with a heavy gale of wind blowing; if it blew a heavy gale of wind, I think that would not be sufficient. I have been in a merchant-ship and have got my cables a-shore to hold her in Dover Harbour as it is.

481. She would require a whole cable?—Yes; or two halves.

482. Can ships ride in Dungeness East Bay during an easterly gale?—No; they cannot.

483. If they came to Eastbourne Bay to the eastward of Beachy Head, in a south-west gale, would the Holywell Bank be any defence against the sea setting into the bay?—Of course it would break the sea, and be some protection.

484. With the Royal Sovereign shoals lying about three miles and a-half off shore, would there be any difficulty in ships running out to the eastward from a harbour in Eastbourne Bay?—Yes; with line-of-battle ships there would.

485. Confine yourself to large-class steamers and frigates, and large merchant-ships?—The largest merchant-ships would not run in.

486. Within the breakwater in Seaford Bay, Seaford Head would bear south-east — Yes.

487. You still think there would be no difficulty in running for that harbour in a south-west gale?—I do not think there would be any difficulty.

488. And you think there would be no danger?—No.

489. (*Captain Washington.*) You would not consider it dangerous in a south-west gale to run for a harbour of refuge in Seaford Bay, remembering that Seaford Head bears south-east-half-east, at two miles and a half distance?—No.

490. Your great objection to a harbour at the eastward of Beachy Head arises from the Sovereign Shoal, does it not?—Not altogether from that, but from the shoal water there is inside of it for large ships.

491. You do not mean merchant ships?—There is room for merchant-ships in general; but a large merchant-ship, an East Indiaman, for instance, drawing 22 feet water would not attempt to go inside the Sovereign.

492. Not even for a harbour of refuge?—No.

493. What should you, as pilot, do in such a case?—I should go to the Downs or down Channel, or to Margate Roads, round the Foreland.

494. (*Captain Fisher.*) Supposing you were on board a less ship than an Indiaman, and there was a gale, and you wanted to get refuge for the night, and there was a breakwater under the Head, would you prefer a breakwater to the east or the west of the Head?—If bound down Channel. I would prefer one to the west of the Head.

495. That is to say, at Seaford?—Yes.

496. All our harbours in this part of the Channel are tide harbours?—Yes.

497. In case of a war, it would be necessary to have steamers ready to slip out at a moment's notice; where, in your opinion, is the most eligible place for a breakwater to be



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constructed for those steamers to lie protected from the enemy?—Dungeness and Dover are the narrowest parts of the Channel.

498. Which should you prefer, considering that the protection of the vessels would be an object?—Dover would certainly be better for protection than Dungeness.

499. What is your reply, taking the whole question together?—Then I should say Dover.

500. (*Adm. Dundas.*) If that breakwater, which it might be necessary to construct for the protection of steam-vessels, were made to protect the trade also, would not that be a great advantage to the country?—Certainly; they could make a battery of it if they liked.

501. Do you think that Dover is the most eligible place to contain steam-vessels acting against the enemy for the protection of trade, and for shelter to merchant-ships?—No, I should say Newhaven is the best for merchant-ships.

502. Take the case of the narrow seas?—Very near there I have seen a dozen sail of privateers off Beachy Head at one time.

503. Next to Dover, what should you say is the best place as a place for a squadron of steamers, and at the same time for protection?—There is only Dungeness that I know of, till we get lower down; the east of the Head would do as well as the west as to steamers.

504. Are you to be understood still to adhere to Seaford Bay as being the best situation for a single harbour of refuge to be constructed, if there is only one?—Yes.

505. (*Capt. Fisher.*) In your opinion, as a pilot of long standing and great experience, where would you recommend a second one to be placed, supposing it were determined to have two?—At Dover.

506. In answer to a question put to you respecting the Brake Sand, you said you had known it for fifteen or twenty years; do you know whether the marks for running up for the Little Downs, inside the Brake Sand to Ramsgate Harbour, have ever been altered?—No, we use the same marks.

507. Do you know the turning marks to have been altered?—No, I turn by the same marks.

508. (*Capt. Washington.*) Supposing a vessel running down Channel with a south-east wind, if the wind shifts to the south-west and comes on to blow hard, would it not often occur that they could get shelter to the east of Beachy Head, when they could not get round it?—The large ones would bear up for the Downs.

509. (*Chairman.*) Supposing a war to break out, and a harbour to be formed immediately for steamers to meet the enemy and protect the commerce of the country, where would you build that breakwater—at Seaford or at Dover?—I should think Newhaven, Seaford Roads.

510. Where were you born?—I was born at Harwich.

511. You are now living at Woolwich?—I have been at Woolwich seven years.

512. Where did you live before that?—At Harwich; I have been in the service 24 years, and have always been away from my home till now.

513. You have never resided down to the West?—No.

[ *The Witness withdrew.* ]

Mr. *Fortunatus*  
*Pellatt.*

Mr. *Fortunatus Pellatt*, examined.

514. (*Chairman.*) What are you?—I am master of an Ordnance sloop.

515. How long have you been a navigator of the English Channel?—I have been up and down many years. I have been master of a coasting-vessel upwards of twenty years.

516. Between what places?—Between the river Thames and Portsmouth and Plymouth, and across to Ireland occasionally.

517. Have you ever been in difficulty and distress for want of a harbour of refuge in the neighbourhood of Beachy Head?—We have often had occasion to run back to the Downs when we have been to the westward of Beachy Head between that and the Owers.

518. If there had been a harbour constructed in the neighbourhood of Eastbourne, you would have found it a shelter, and have been glad to run for it?—Yes.

519. (*Admiral Dundas.*) Supposing you had the choice of a situation for a harbour of refuge, where would you place it, taking into consideration the convenience of the trade in general, and at the same time the accommodation of squadrons of steamers, the same being accessible at all times of the tide?—Newhaven is a very good harbour, but it would require the existence of a breakwater to cover it.

520. Do you mean by Newhaven that you would enclose Seaford Bay by a breakwater?—Yes, or it would not be an outlet as well as an inlet.

521. Which on the whole do you consider as the best?—I consider that Newhaven would not answer unless it was covered by a breakwater.

522. Do you mean that you think that would be the best?—I think it would be a good situation.

523. On which side of Beachy Head would you prefer the harbour if you had to fix the situation?—On the west side for an outlet.

524. Would not vessels have a difficulty in getting out of that bay if they wanted to get out when it moderated?—With an easterly wind, they could get out much better than if it were to the westward.



525. (*Chairman.*) Are you acquainted with the anchorage about Dover Bay?—Yes.

526. What sort of holding-ground is it?—It is not very good; it is very indifferent holding-ground, and the water runs steep close in.

527. What sort of holding-ground is it at six or seven fathoms?—It is not very good holding-ground there.

528. Have you often anchored in it?—I have often in six or seven fathoms. We go very close in. It is only anchorage for small vessels. I have anchored also in deeper water, but it is not considered good anchoring-ground in Dover Roads.

529. What is the anchorage north of Dungeness?—That is very good holding-ground, but the water is very shallow there, and they have a shoal that runs all the way up along the land, but they have a very good place just below Romney; between Romney and the Upper Batteries there is a place falls in there, just below the Swallow Bank, which would form a harbour. There is a bight runs in there, a great piece of water in there.

530. Have you ever served as a pilot, or only in command of a vessel?—Only in the command of a vessel. I have been master of a coasting-vessel.

531. Have you always piloted your own vessel?—Oh, yes.

532. Have you been acquainted with the anchorage between the Brake Sand and the Small Downs?—Yes.

533. Have you any knowledge of the depth of water vessels anchor in generally?—Five, six, and seven fathoms.

534. Have you ever been aware of the Brake Sand shifting?—No; but I am aware, there are several small patches without it and within it.

535. Are those patches formed by the shallow water inside?—In many parts.

536. What depth of water is there on those patches?—Some of them not more than two fathoms and a half and three fathoms at low tide.

537. Have you ever known the middle buoy of the Brake to be shifted in consequence of a change of the sand?—No; I know there has been a buoy placed there a little while ago, a chequered buoy, that did not used to be there on a knoll.

538. How long ago was that placed?—I think within the last two years.

539. How much is that within the middle Brake-buoy?—This is on the elbow of the Brake. It has been only recently laid there. There was no middle Brake buoy there formerly.

540. Do you know anything about Foreness Harbour?—Yes.

541. Is that a position where a harbour of refuge would be of any use?—I think not.

542. Do you know the Goodwin Sands?—I know them very well; Trinity Bay.

543. Do you think it possible to make a harbour there?—I think for such a place as the Downs, with a chalk bottom, it would be a very good place.

544. Do you think that in Dover Bay a good harbour might be made?—No; I think not.

545. What do you think of Dungeness?—I think they might make a good harbour at Dungeness, equal to the demands of the merchant-ships and trading-vessels, there being no shelter from the Isle of Wight to the Downs but Dungeness; under Beachy Head there is no shelter, which there is under the Ness.

546. (*Adm. Dundas.*) All these questions are put upon the presumption of the thing being to be made. Supposing a harbour, or two harbours, to be formed for the protection of the trade of England, and also in case of war, that steamers might be ready to protect them, in what position, Margate, Ramsgate, Deal, the Brake, Dover, Dungeness, Beachy Head, either one or the other, what place would you select?—I should say it must be either Newhaven or to the eastward of the Head between that and Pevensey Point.

547. In case of war, as it would be necessary to keep steamers in readiness to slip out at short notice, which is the most eligible place for a breakwater to be constructed for those steam vessels to lie protected from all winds?—I should say Trinity Bay.

548. Wherever they lay there must be an opportunity of getting their coals on board?—If such a thing was to be, that a breakwater was to be erected, or a harbour made, there would no doubt be a place made as well as a fortification, and a landing for coals.

549. In the Goodwin Sands?—Yes.

550. What is your objection to eastward of the Head?—Because I think it would take such an extent of ground; the water runs off very shallow, you can go within half a mile of the shore, and go off seven or eight fathoms water.

551. You are not afraid of the Sovereign Shoal?—No; there is plenty of room between that and the Sovereign Shoal.

552. Suppose a breakwater formed there, with a light on the Head and a light on the intended breakwater, could any ship run for it?—Yes.

553. Would that be a preferable place to a breakwater off Seaford?—I think that it would be best to the eastward of the Head.

554. Suppose a breakwater formed under the Head, what are you afraid of in running out?—There is nothing to be afraid of in running out.

555. Suppose I am anchoring there and want to go up Channel, is there anything to prevent my going through the eastern channel?—No.

556. Do you conceive that that is the best place for a rendezvous and asylum for vessels, whether coasting or waiting for a wind, or for armed steamers ready to slip?—I think that would be the most eligible situation, in consequence of the other being a bar harbour.

Mr. *Fortunatus*  
*Pellatt.*

8th May, 1844.



Mr. *Fortunatus*  
*Pellatt.*  
 ———  
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557. The questions suppose a harbour to be built, suppose a breakwater formed to the east of the Head, lighted, as was mentioned, and that you had a breakwater formed like the one at Plymouth, off Seaford, and you were in a ship two or three leagues to the westward and a dirty night coming on, where should you bear up?—For the one to the eastward, in consequence of the shelter of the Head.

558. (*Sir H. Pelly.*) You stated that Trinity Bay would be the best place for a harbour, supposing you could not make it in Trinity Bay, is there no part of the Downs in which it could be made?—I do not see any in the Small Downs; there is not an opportunity for a vessel getting out. As you approach Ramsgate, you get into very little water; and in placing a harbour there I do not see how she could get out.

559. Take it lower down towards Deal and Walmer?—Then I do not see how a vessel can get out when it is blowing a gale of wind.

560. What would prevent her getting out of one just as well as out of the other?—The one to the eastward of the Head is an open space, as the one in the Downs. Unless it is below Walmer, I do not see how they could get out; if it was down off Walmer, they might have a chance; but I think if it is a fog, and particularly in the night time, I do not apprehend they could get out in the night time.

561. (*Chairman.*) Suppose a vessel to be at anchor within the Brake, that she cannot get to the northward because of the shallow water, and a gale sets in from the south-west, she would not be able to get round the south end of the Brake?—No.

562. Therefore she must ride it out?—Yes, that is what I mean.

563. Have you ever gone over the shallow water between the Brake and Ramsgate?—Yes.

564. What depth of water have you got?—There is one part where you see the sea break; it is dry at low water. I have seen it all dry, and have seen a ship lost there when I have been at Ramsgate.

565. Are there not two channels out to the northward?—Yes; but the Old South Passage is not fit for a ship at low water; sometimes there are nine, or ten, or eleven feet only, and it must be people who are continually in and out to find it out. There is not a passage for any but small vessels which are running for Ramsgate; there is only nine or ten feet.

566. Did you ever anchor in Trinity Bay?—No, but I see how it is situated; I have been close inside of the Gull Stream there.

567. You form your opinion of the harbour there from what you have seen, not from having been in it?—Yes.

568. Are you acquainted with Mr. Bush, the civil engineer?—No.

569. (*Captain Fisher.*) The Commissioners understand that you have been for 20 years master of a coasting-vessel?—More than that.

570. On what part of the coast would you prefer having a harbour of refuge constructed that should give ample protection to vessels bound either down or up Channel from the river Thames as far as the Isle of Wight?—I should say in Eastbourne.

571. Did you not state that you considered Newhaven, covered with a breakwater, would be best?—Yes; but the other would be the most eligible situation if it was intended for ships to go in and out either way.

572. If there was to be one harbour of refuge constructed for ships of every class, it should be one to the eastward of Beachy Head?—Yes.

573. Do you consider that a harbour constructed there would be accessible to vessels of all descriptions, men-of-war as well as merchant-ships, either in bad weather or by way of protection from an enemy during the night?—Yes, I think it would.

574. You would prefer that situation to a harbour constructed in Dover Roads or under Dungeness?—I think that is preferable.

575. Are you of opinion that a safe and good anchorage might be made anywhere between the Brake Sand and the beach?—Yes, it might be made in any water; but I do not mean to say that there would be an outlet in any water. A vessel could not get out at certain times.

576. As the entrance to the Brake must lie open to the south, what protection could they have to the anchorage?—None, unless the breakwater went with a sweep.

577. Then the breakwater must come in more towards the shore?—Yes.

578. Unless the front of it is covered, it must be an open anchorage?—Certainly.

579. A breakwater being carried so as to cover it from the south-west to the south-east wind would make it a complete harbour?—Yes.

580. In your opinion, with a breakwater or a shelter constructed on the north part of the Deal Sands, or any part of the Brake, would there be an opening sufficient for ships to go to sea to the westward?—In a gale of wind, I do not apprehend there would be room enough for a ship to go to sea; supposing the wind blowing south-south-west, she could not get out; there is not water enough for a vessel to get out at low water.

581. There is good anchorage, but, in your opinion, no means of getting a vessel to sea?—Yes.

582. If a pier were thrown out from the shore, would it not make a great drift of tide?—It would make more current; the tide runs very rapidly there.

583. At what rate does the tide run?—I suppose, in spring-tides, three knots or three and a half.

584. Do you mean in the Small Downs?—No, it runs in the Small Downs from two to two and a half.



585. (*Chairman.*) Do you wish the Commissioners to understand, that by narrowing the passage you would get a greater rush of the tide?—Of course.

586. Suppose an enemy's vessel off the North Foreland, and our vessels are lying inside this breakwater at the Brake, must our vessels come to the southward of the breakwater before they can get to the North Foreland?—Yes; supposing it to be low water, there is no other passage.

587. Supposing an enemy's vessel to be off the North Foreland, she would not be able to get in at this passage any more than our vessels could get out?—No.

588. Are you aware whether there is water enough for the Ramsgate steamers to go out through the North Channel at low water?—Yes; those small steam-boats that use Ramsgate.

589. What draught of water?—They draw from six to seven feet, some of them may draw eight, but the average of them not more than six or seven feet.

590. Do you know the least depth at low water?—From nine to ten feet, it is very narrow then.

591. There is the Cliff Channel also?—That is one that is not used except by the fishermen, and that only at particular times, the Old Cudd Channel is that generally used.

592. Where were you born?—At Purfleet, in Essex.

593. Where do you reside?—In Woolwich; I have resided there these 30 years.

[*The Witness withdrew.*]

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Mr. *John Meckiff*, examined.

Mr. *John Meckiff*.

594. (*Admiral Dundas.*) What is your occupation?—Master of the “*Lord Vivian*” Ordnance vessel.

595. How long have you been in Channel navigation?—About 17 or 18 years, I have been to and fro in the Channel.

596. As a pilot?—No; in the Ordnance.

597. With what part of the Channel are you mostly acquainted?—Portsmouth and Plymouth; from the river to those places.

598. You have been to Dublin?—Yes; I am bound to Dublin now.

599. In navigating the Channel in bad weather, in winter time, if you had the choice of having a harbour constructed anywhere, where would you think it would be most convenient, between Portsmouth and the North Foreland, having reference to the trade in general?—I never was in anything but those Ordnance vessels; you might make a very good harbour to the east of Beachy Head, that would be a very good place.

600. Would you have any apprehension of inconvenience from the Royal Sovereign Shoal, and the other shoals?—There is nearly or quite three fathoms on the Royal Sovereign Shoal.

601. What does your vessel draw?—11 feet when she is loaded.

602. Supposing vessels lying at anchor behind a breakwater at Eastbourne, and having occasion to come out at the other end would, there be any inconvenience?—A smart vessel would go out either at one end or the other, down to the Head or up to the Ness.

603. You would not have any hesitation in getting her out, and going round in shore of the Royal Sovereign?—No.

604. With any description of vessels?—I would not try it with a large vessel; but with a merchant-ship, drawing 18 feet, I would.

605. This is meant to be a shelter for the trade in general?—I know very little of large ships, I do not understand anything about them. I have never been used to be in one.

606. You would have no objection in taking charge of a large ship?—I should like to go in one before I took charge of her; I have never been in a square ship in my life, nor my father before me; I have always been in those small Ordnance vessels.

607. You would prefer a breakwater to the east of Beachy Head to any other?—Yes.

608. Suppose that a harbour were to be provided for a squadron of steamers for the protection of trade, and the purpose of watching the enemy, what situation should you prefer next to Eastbourne?—They might form a very good harbour at Dungeness.

609. In case of a war, it would be necessary to have steamers ready to slip out at a moment's notice to protect the trade, and also to have a place where they would be protected from attack. Now, looking at the whole Channel from the Downs, in what place would you prefer to have a squadron of steamers?—I think the Ness would be a very good place for it, either the one side or the other; the east side of the Ness would be best perhaps.

610. You mean for a second harbour?—Yes.

611. Did you ever hear of Trinity Bay in the Goodwin?—I have heard tell of it, but never knew it.

612. The Brake?—I believe I have.

613. Could a harbour be constructed there?—There might be; there would be no back-passage out of it.

614. Do you know Foreness?—Off the North Foreland there is a rock called the Foreness Rock.

615. Is that an eligible place for a harbour?—It is a very straight shore there.

616. What do you think of Dover for a harbour of refuge?—You might form a break-water in front of the harbour.



Mr. John Meckiff.  
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617. How is the holding-ground in Dover Bay?—Very good holding-ground, a little further off we generally anchor in seven or eight fathoms; that is very good holding-ground.

618. (*Sir W. Symonds.*) Would you prefer, for steamers, Dover to Dungeness, or Dungeness to Dover?—I should think Dungeness would be the snuggest of the two.

619. Will you state what are the reasons why you prefer Dungeness?—I think there would be a good entrance either way.

620. Do you consider the holding-ground better?—There is very good holding-ground at the Ness, it is clay ground.

621. (*Chairman.*) You give the preference to Eastbourne Bay above other places, and to Dungeness in preference to Dover?—Yes.

622. Where do you reside?—At Woolwich.

623. Where were you born?—At Portsmouth.

[*The Witness withdrew.*]

Mr. William Bush.

Mr. William Bush, examined.

624. (*Chairman.*) Are you a civil engineer?—Yes.

625. How long have you been in that occupation?—About five and thirty years.

626. You were bred to it?—Yes.

627. Have you ever been at sea?—Yes, I have been at sea; I was in Calcutta five and thirty years ago, as an engineer; I was then under Colonel Gascoigne.

628. Have you a plan of a harbour which you propose to construct by means of iron caissons on the substratum of the Goodwin Sands?—I have.

629. Have you your plan here?—I have. (*The witness produced the same.*)

630. To what depth have you bored on the Goodwin Sands, and what is the nature of the substratum on which you propose to rest your caissons?—The caisson was sunk through the sand eight and twenty feet. We did not bore at all; we got down to 28 feet; there we could see the milky substance of the chalk within the caisson.

631. Do you propose that the caisson should find its own way by its weight?—Yes. This is the drawing; it is like one diving-bell working on another, and there are the air-pumps, with men working on another. This is the model of it (*producing the same*). Here is sufficient air in the chamber to last a dozen men for a day, and to prevent the loss of the air; they come through the man-hole. (*The witness pointed out the mode of operation.*)

632. It appears that you have already sunk a caisson?—Yes.

633. Of what dimensions?—Thirty feet diameter.

634. Is this on the same plan as the caisson which you had on Deal Beach?—Exactly the same.

635. What has become of the caisson which you sunk?—It was carried away in a gale of wind, on the 24th October, 1842.

636. Swept bodily away?—Yes. It is supposed that the “Nancy” run foul of it; but I was not there at the time.

637. If you were authorized to carry on such a work, should not you have a constant apprehension of its being carried away?—Of course I should now be more careful, for I should put a light upon it.

638. That is assuming that it was run foul of?—Yes.

639. But you do not know that it was run foul of?—I received a letter from Lieutenant Batt that he saw this vessel very near it, and that it was lost.

640. When you sink your caissons, is there not danger of their being carried away as this was?—I should say not; there was 10,000 to 1 that it should never be swept away.

641. Your plan is to surround the whole of the Goodwin Sands?—Not the whole of it.

642. You propose to surround 2000 acres?—Yes; the other side is deep water. On the back of the Goodwin there is 100 feet of water, and by raising an embankment of 12 feet high it would fill up; the Sand would fill up after this embankment.

643. You propose to surround the Sand by caissons?—Yes.

644. Your object is to form the Goodwin Sands into an island?—Yes, or into an harbour of refuge; there is 2060 acres of water there, which would be the finest harbour in the world if it were carried out.

645. Besides the caissons which you would use in surrounding these Sands to make an island, you would use your caissons to make a harbour?—I should go on 100 feet at a time; I propose they should be formed in the dock-yard, 100 feet in length, and floated out. We had every disadvantage on the beach, because we could not get them off the beach after we built them.

646. As your caissons are intended to be carried out 11 miles, have you ever estimated the number of caissons that would be required for that?—Yes.

647. How many?—I have not my papers with me, but there would be 53 in a mile.

648. That would make 583?—Yes.

649. You say, in your papers, that you would undertake it at your own cost, with the assistance from the dock-yards?—That is for one caisson of 100 feet to show the principle.

650. You are understood, in your Report, to say that you would undertake this work at your own cost, with the exception of certain assistance to be given to you by Her Majesty's



dock-yards, what is the nature of the assistance which you would expect from the dock-yards?—The dock to build it, and to float it out.

651. Is that all that you would require?—With the assistance of a steamer to tow it out.

652. Do you mean that you would undertake the expense of surrounding this island?—No, that was the expense of one caisson, to show the principle, before Government votes a large sum of money for a harbour of refuge, to show that it can be carried out; when that is shown, they may add to it, and carry it out.

653. What sum of money do you suppose it would require?—It comes to about 800,000*l.* per mile, or from that to 1,000,000*l.* a mile. The caisson I constructed cost me about 2*s.* a cubic foot.

654. It would cost 8,000,000*l.* altogether?—Yes. There is plenty of shingle to fill it up with cement and shingle.

655. Have you never estimated the expense you suppose it would cost, when you propose this work?—Yes, about 8,800,000*l.*, or about 800,000*l.* per mile.

656. What is the ultimate object you propose by converting it into an island?—To obtain a harbour.

657. How long were you building the caisson which you sunk?—We were about six or eight months building it.

658. Suppose a work of that kind to be undertaken for 11 miles in extent, how many years would you give for it?—It would depend on circumstances, and on the supply of money.

659. Suppose the money to be found?—If you once form the nucleus you could go on at different parts, and expend 1,000,000*l.* a year.

660. (*Admiral Dundas.*) How many years would it take to complete it?—Eight or ten years.

661. Supposing Government found it impossible to undertake this great work, where, in your opinion, would be the next best place, between the River and Portsmouth, to form a harbour, which would combine two things, protection to the commerce of the country and a station where steam-boats could be congregated to slip out and annoy the enemy?—I hardly know a place which is fit for it, unless there was a breakwater carried out; then it might be placed at Newhaven. I should say it should be the centre of the Downs.

662. Do you know anything about the south-east coast?—Yes; I know all the coast.

663. In what part of the Downs?—I should say opposite to Deal is the best place to take out a breakwater.

664. Do you prefer that to its being further to the westward?—I do not know, I am sure; Portsmouth is so near a point if a vessel was outward-bound; or inward-bound she would wish to get into the Downs.

665. Suppose a war broke out, and you wanted your steamers to be ready at a moment's notice, all the present harbours are tide-harbours; we want a breakwater-harbour, where vessels might be lying ready to slip out in an instant, and a place where merchants could find refuge in a gale of wind. Where would you place it, between the Downs and Portsmouth?—I should say on the Brake, or the Ridge, or the Varne; that there might be a breakwater built.

666. (*Captain Washington.*) Do you remember the situation of the Varne?—Yes.

667. What would be the object of building a breakwater there?—It might be a shelter for ships.

668. (*Chairman.*) Putting aside the Goodwin and the Ridge or Varne, and looking to the various places on the coast, what part of all the places, Dover, Folkstone, Dungeness, and either side of Beachy Head, should you recommend?—I do not see any place on that part of the coast where it would be any advantage for a ship to run out.

669. The question supposes a breakwater to be made?—I do not know any place at all where it could be carried out to any advantage.

670. Suppose a breakwater at Dover, what do you think of that?—I do not think that would do at all. I do not approve of Dover for a harbour at all.

671. Have you seen a plan of the breakwater? (*It being shown to the witness.*)—That is a very good plan; but I do not see why a harbour is required there, for I should never go into Dover. If I were going to the East or West Indies, I should run down Channel.

672. (*Admiral Dundas.*) Suppose a war to-morrow, and there was protection wanted for steamers?—Then Dover would have a great advantage, being a fortification for protection, but not as a harbour of refuge.

673. Where would you place a harbour where steam-vessels could lie ready to slip out at a moment's notice, and where vessels could lie wind-bound in a gale of wind?—I should say Dover is far preferable to any other place that I know in some respects. It would do for men-of-war. We want, in case of war, a place where we could run in our large ships; so that if France had a large fleet of steamers, they might run in there; but if we were in the Downs, we might run either way. For a fortified harbour, of course Dover would be far superior to any other place,

674. If you formed a breakwater, on which side of Beachy Head should you form it; eastward or westward?—It might be built I suppose somewhere about Hythe. Beachy Head, I should say, is too near Portsmouth.

675. Do you offer your opinion to the Commissioners as a seaman in respect of the maritime position of the harbour, or as an engineer?—I do not offer my opinion as a seaman; I know the coast pretty well.

676. (*Mr. Walker.*) In what character do you offer your opinion as to the position of a harbour of refuge?—As an engineer.



Mr. William Bush.

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677. How long were you constructing your caisson before it was carried out?—Eight months.

678. Were not you there two years?—Yes; the first year we got it afloat, and then bad weather came on, and we sunk it near the pier, and destroyed it; then the next year I built another at the dock-yard; I had leave from the Admiralty to build it there.

679. You built it by the aid of the Government?—Yes.

680. What was the dimension of the caisson?—Thirty feet diameter, diminishing one foot in six.

681. Looking at this model, that is circular as it appears on the plan?—Yes.

682. Do you mean the gentlemen to understand that all the caissons are to be upon that principle?—Yes, they might be built in the dock-yard, made complete, and floated out; there would be nothing but to turn the cock and let the air out, and they would sink immediately.

683. You would make them of cast-iron?—Yes.

684. Do you do that by the same means, by chambers?—Yes, if I was going to build them in hundred feet lengths, I should make only two chambers.

685. (*Sir Howard Douglas.*) What do you propose on the Goodwin?—The base was 30 feet wide, diminishing one foot in six; 42 feet high, 12 feet above high-water mark.

686. Did you ballast the lower part of your caisson with concrete?—No.

687. When it broke away, was there any concrete in it?—No, it had not quite got down to the bottom, it did not go down six inches for two months.

688. Did you find the lower part of the 28 feet very hard?—Yes, hard black sand, the whole of the sand is very hard black sand.

689. It went a certain way itself, did it not?—By the ebb and flow of the tide, if the wind blew very strong it would cant it over in this way (*showing it*).

690. What kind of progress did you make in bringing it down?—It went down of itself, and went right down to the bottom.

691. There was no excavation?—No, none at all.

692. It went 28 feet down by its own weight?—Yes, there was 12 feet of water, and the caisson was 42 feet high.

693. You mean that there was 12 feet in the water, and 16 feet in the sand?—Yes.

694. Did it go down 16 feet into the sand by its own gravity?—Yes; I never put a shovel into it, every time the tide came up, it threw up the sand underneath.

695. Had you water inside?—Yes, when the sand was up to the first chamber we went down to excavate it; then when it came to high-water mark again, the sand was all gone; then it canted over sideways.

696. Did the high tide cover your caisson altogether?—Yes, we had to put six more plates on it when we took it out, when it was just 42 feet; then when we got it out, it was a very fine calm night, we worked at it all night, and had fixed a tier of plates on; then when it came to blow a little strong to the westward, that caused the sea to pour in over the caisson, and it sunk so fast that the water rolled over and struck against those plates; the tide rose two feet higher that morning, and the pressure of the water broke off those plates. That was the pressure of the water.

697. Should you have no difficulty in dealing with your caissons in eight fathom water?—No, I think there would be no difficulty if they were made complete in the dock and floated out; they can be made to any extent, and of course they could be so constructed that they will float according to the displacement of water.

698. (*Lieut.-Colonel Alderson.*) What water did your caisson draw when you took it to the sand?—Twelve feet exactly.

699. Your plan shows the section, and there is also an inner chamber of the same kind?—Yes.

700. Then there is a large outside cylinder a little conical, had you any inner chamber in its place?—This was all perfect.

701. You had some people on the chalk 28 feet below low water, had you any people at work below low water before your caisson gave way?—This only shows that it was to be carried out, the men were not there.

702. Were there men excavating below low water before it broke away?—No, we did not require to send men down, we worked on the sand at low water.

703. You never had an opportunity of testing the experiment by sending your men down to work at low water under those chambers?—No, we did not go down.

704. How did you find that the sand at 16 feet was hard black sand?—We could see it in the bottom of the chamber; the chamber would rest on the sand; it would sink, the same as a ship.

705. You never put pick or tool into the sand?—No, we did not require it.

706. You were understood to say, that you never had any persons below the level of low water?—Oh, yes, I had; and I have been down there myself working on the Sands. Sometimes, by opening the valve, the sand would come through into this cross chamber, but when I was on the beach we have pumped the air in here and gone down.

707. You had no means of steadying it?—No; the base being so large, steadied it.

708. But it went out of the upright?—Yes; at one time it was as much as four feet out of the upright.

709. How long after your caisson had attained its position was it that you met with the accident you have referred to?—These plates were destroyed the next morning they were put in.



710. Was there any proof that it received an injury from a ship?—I know nothing more than from a letter I received. Mr. William Bush.

711. (*Chairman.*) Is there anything further that you wish to state?—I have nothing further to state; but if it makes no difference where the harbour is, I should be very happy to enter into any arrangement for the trial of my plan. I do not want the Government to be at a farthing expense. I will do it myself if they will allow me. 8th May, 1844.

712. What will you do?—I will carry out a caisson.

713. You mean an experimental caisson?—Yes; to show the effect.

714. You have already put down one as an experimental caisson, and that has been carried away?—Yes; but I would not attempt to build one, unless I have the dock-yard to build it and float it out.

715. Where would you wish to build it?—If it is to go into the Downs, I should like to build it at Sheerness. It would float out like a ship.

[*The Witness withdrew.*]

Adjourned to to-morrow at 12 o'clock.

Thursday, 9th May, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Sir John Rennie, examined.

Sir John Rennie.

716. (*Chairman.*) The Commissioners have before them a plan of yours for enclosing the small Downs. In the evidence you gave before the Committee on Shipwrecks, you stated, in answer to question 5966, that it will be four miles and a half in length, but in your Report to the Commissioners of Ramsgate Harbour, you say it will be five miles, will you have the goodness to explain how that is?—The fact is, that in any work constructed upon the Brake, the operation of accumulation, which I consider will be produced by the works if conducted in a judicious and proper manner, will be rather to raise and increase the shoal in a particular position; it may be a quarter of a mile, more or less, for it is difficult to state whether it will be five miles or four and a half, till I know specifically the whole extent of the operations intended to be carried on. It is not like constructing a mole out in the open sea, where the whole work must be done entirely artificially; but here the object is to endeavour to make nature operate with us in conjunction with art, so that it is a very difficult thing to say in the first outset what would be the whole quantity which would be required to be done. I have given, in the Report to the directors of Ramsgate Harbour, an outside estimate, comprehending everything; but, I believe, provided the work be carried on, only a portion of it will be required.

717. Going to the greatest extent you contemplate under the circumstances you have stated, what would be the distance?—Five miles.

718. In answer to question 5967, in the same Report, you state the expense for four miles and a half to be from 1,250,000*l.* to 1,300,000*l.*, but in your Report to the Ramsgate Commissioners, you state it at 3,280,000*l.*, or, if reduced to a work of one mile, 850,000*l.*, some explanation appears necessary in reference to the great difference between the two first sums?—My answer to the Shipwreck Committee was intended to convey the idea that 1,200,000 to 1,300,000 would make a good harbour; and in the estimate I made, which is contained in my Report to the trustees of Ramsgate Harbour, it is stated that, provided the whole of the sand of which the Brake is composed should be scoured away, and it should be necessary to replace it with an artificial breakwater, the entire cost would be, as I have stated in my Report, 3,280,000*l.*; but, as I have stated also in that Report, that there is no doubt, in my opinion, that nature will do a large portion of the work itself, I am satisfied that a very considerably less sum than that will only be necessary; but I have put it as an extreme case; and I must refer to that Report as to what I have said with regard to the particular mode of constructing this work. As it will be a work of accumulation, produced by artificial means to a certain extent, it is very difficult precisely to state the amount; but I am quite satisfied that the sum I stated in my evidence before the Shipwreck Committee, namely, 1,250,000*l.*, would be ample to make a very efficient harbour there.

719. You state that the shoal in its movement rather extends outwards than otherwise?—Yes, at the end.

720. The fact of the case, as reported by Captain Bullock, shows otherwise, that it has not extended outwards?—I think the old charts, on which persons must go in judging of the existence and form of these shoals, have been in general so very vague that it is very difficult to state where any alteration has taken place in a great extent. I think the bearings may not have been taken in that correct and accurate manner in which they are now taken; and, consequently, that a great allowance must be made as to these measurements; but if you refer to the cause which has produced these shoals, they must be taken, not merely from the position of the shoal itself, but with reference to the adjoining headlands: and I doubt whether it can historically be shown that such an alteration has taken place in reference to those headlands, I mean the North and South Forelands, as to produce such an extraordinary change of the Brake as we have heard of from Captain Bullock.

721. That of course must be matter of conjecture?—To a certain extent it must be matter of conjecture, but I think we must look to the natural causes. If you find that the



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projection at the North and South Forelands has been reduced very materially in a certain number of years, and that they are brought nearer to a line with the outer portion of the Brake, that is proof of the fact; but it is impossible to lay it down exactly without reference to those historical facts. There may also be other causes in operation which may require explanation.

722. Those you have embraced very much in your Report?—Yes.

723. Supposing the work to be carried to the greatest extent, you state that your estimate amounts to 3,280,000*l.*, and if reduced by the circumstances to which you have referred, to 1,125,000*l.*; and that if the distance is confined to one mile, it would be 850,000*l.*?—I should like, before I give a specific estimate for any minor portion, to have a little time to consider the matter; and I would rather give my views on paper, if I may be allowed; for in writing a Report, like that before the Commissioners, the great object was to apply principles, and to show the extreme expense which would be incurred; but if the measure is to be modified in any way, I should like to reconsider that, and state it in writing.

724. What would be the limitation to the work if the expense is to be only 1,300,000*l.*?—I will answer that hereafter, in a paper I will deliver in; but I beg to be permitted to read one passage from my Report to the trustees of Ramsgate Harbour, which may serve to illustrate this: “With regard to the probable expense of constructing a work of the magnitude above recommended for the Brake, this will in a great measure depend upon the extent to which it is carried. If it be made of sufficient magnitude to cover the whole space from the North to the South Buoy (which is probably far more than is necessary), where there are six fathoms at low water, it would require to be nearly five miles long, the cost of constructing which would be very considerable; but if it be correct, as stated in the former part of this Report, that this bank has been formed by the deposit occasioned by an eddy, it is very probable that in making proper works to increase the eddy the deposit might be made to accumulate to such an extent as to materially reduce the quantity of artificial work to be performed; but even supposing that the whole of the sand forming the Brake should be removed by the current, which is extremely improbable, because any works placed upon it would certainly have the tendency to increase the eddy, and consequently the deposit, rather than diminish it, the cost of replacing the whole by an artificial breakwater would not exceed 3,280,000*l.*; but as probably a length of about 1500 yards or a mile would suffice, at least for some time, the cost of this would be 820,000*l.*” Therefore, with regard to that, I have not represented that I consider those figures as certain; and before I speak definitively as to the cost, I should wish to have an opportunity of reconsidering it; and if any certain length to which it might be considered advisable to carry the work is stated, I will give a specific answer to that, and it will be a question whether, in constructing the work, it will be desirable to carry it above high water, or to keep it at the level of half-tide.

725. If only one mile is done at a cost of 820,000*l.*, what shelter will it give, or what protection from the south wind and the heavy sea brought in from that quarter?—If it is proposed only to make a mile, I should give a different design altogether. If you make it two miles, then I should take another position, and so on.

726. You would not start from the north in that case?—No, I should make it altogether different.

727. You think that one mile would give a considerable protection to the shipping?—Yes, if properly placed; but if one mile only were done, a different form must be adopted, in order to give protection from a particular quarter.

728. Supposing the work to be carried to the full extent you contemplate, it appears by the plan on the table that it would be open to a heavy sea running in at the mouth of the anchorage?—I do not consider that the precise plan laid down here is altogether settled. If the work were to be carried out, it would require to be modified according to the particular accumulation of the shoal; it might be so arranged as to give the desired protection when the work was carried into effect. As to this particular mode of converting a shoal into a breakwater, an idea which is rather novel, it must be worked according to the particular mode in which the shoal increases. In carrying such a work into effect, the object would be to keep as deep a channel within as I could; and the scour through it would deepen rather than diminish it. It would be equally an object to give protection to the shipping from the dangerous quarter; and in working these two together, a little modification would be required if the current might be rather inconvenient—the shoal might be increased on one side and diminished on the other—until the desired object might be obtained. In working this, very much will depend upon the skill and judgment with which it is done, and the mode; and before I could give a specific answer to that, I should like to reconsider all those points, and to know the quantity of protection required.

729. Any work to obtain this protection would occasion an expense to be added probably to the estimate?—No; because I consider that the estimate I have given will be ample to give all the protection required. I repeat again, that in forming that estimate I have allowed for any alteration that might be desired; it would not effect the principle.

730. What is the nature of the work you propose?—As I have stated in my Report, the exterior of the work might be constructed of hard rubble-stone, the interior of masses of chalk and shingle, or timber or iron might be used with advantage. But, as I stated before in reply to a similar question, I will give in writing, in more detail, the principle on which the work might be carried out, if the Commissioners require it.

731. It appears, in answer to question 5959, in the Report of the Committee on Ship-



wrecks, that you found no chalk bottom in boring the Brake at the depth of 27 feet; do you, after that, feel a confidence in building on such a bed of sand?—Perfectly; the same cause which has existed continues now, that is, the shoal has been produced by an eddy, and so long as you increase that eddy the shoal must increase, and under those circumstances there will be no difficulty in constructing and in maintaining the works.

732. Are you aware of the great change in the position of the Brake Sand, it appearing from the chart received from the Admiralty that it has gone on bodily towards the shore to the distance of nearly half a mile?—This chart which I have adopted is Captain Bullock's. I have no doubt that the shoal is correctly laid down by Captain Bullock; but with regard to the alteration, I think there are no data to prove that, for I believe the old charts have been so incorrectly made, without regular data from which to measure, that they require to be supported by further evidence.

733. You only suppose that the old charts were inaccurate in laying down the Sand?—Yes. Then, again, I give my opinion upon the present state of the Brake, and the causes now existing to preserve that Brake and to keep the channel open. I take it upon the present state of things.

734. In consequence of this change the Brake Sand occupies a part of the space you intended for anchorage, would the remaining part be sufficiently spacious, and with a proper depth of water, for 300 sail of large merchant-ships?—I think it would.

735. There is a depth of water marked in your plan of 21 and 22 feet, in the inside of the anchorage, and as there is little, if any, shelter from the heavy sea which comes in from the south, do you think that depth of water would be sufficient for vessels drawing 18 feet, allowing for the pitching of the ship?—When once it has been determined to what extent the work on the Brake shall be carried out, there will be no difficulty in so designing the works as to give the desired protection over the depth of water before mentioned; and as the current between the Brake and the shore would certainly be rather increased than diminished, the consequent tendency of that would be to increase the depth of water rather than to diminish it, I have no doubt, considerably.

736. When you undertook to construct a work of this kind on the Brake Sand, did you contemplate that it would be a protection to ships of war?—I did.

737. As our large frigates in the present day draw 21 feet, and merchant-ships of the larger class not less, do you think a depth of water for ships of that magnitude, namely, 21 and 22 feet, being required, it would be necessary in that case to extend the works further to the southward?—We should get four and a half to five and six fathoms.

738. The getting into deeper water would probably be on an increased estimate of expense?—No; I contend that my original estimate will be ample to give that, and when I have time to reconsider the matter, and give an answer to these questions, and to detail the mode of carrying the work into effect, I hope it will appear to the Commissioners that I am right.

739. In answer to question 5978, you say the tide will be increased by putting artificial works, properly managed, on the Brake, and be likely to give an increase of two or three feet of depth to the anchorage, as it must carry away an immense quantity of mud or sand, where do you suppose that would be likely to deposit itself?—I think it will very likely go to form part of the work itself.

740. Is there no reason to fear that it will settle down in front or about Ramsgate Harbour, or tend to increase the shoals at the north end of the proposed anchorage?—I should doubt that very much.

741. It is the anticipation of this increased depth which makes you suppose the anchorage will be sufficient for the large ships?—It is not merely that anticipation, but by extending the works to the southward I should get the depth required.

742. Taking the depth as it really appears by the chart, you admit it is not sufficient for ships of that magnitude?—Certainly it is not along the whole line; but by extending it to the southward, sufficient depth would be obtained.

743. If there is an increased tide, by reason of this work, where it is already known to run strong, will not that tend to make the ships ride very hard upon this anchorage in a heavy gale from the southward, where they would feel the weight of the sea?—I should say not, because by placing the work in a proper direction there would be ample protection for the vessels from the southward, and deep water to enable them to ride in safety.

744. In point of fact, do you conceive the Brake affords shelter from the heavy distressing sea flowing in from the Downs?—The work might be made so that the shipping would be protected if the works were carried into effect properly.

745. Is it known to you that one of the most intelligent members of the Trinity Board, the late Captain Drew, has left a record of his opinion against the constructing the proposed work on the Brake?—That is not the impression I have of Captain Drew's opinion. The former Commission, of which he formed one of the members, allude to the Brake only as being a work too extensive to be taken up. They did not at all enter into the question as to the merits of the plan, but merely as to its magnitude and expense; and Captain Drew, in a conversation I had with him upon the subject, did not appear to me to have decided against it.

746. You are, no doubt, sufficiently acquainted with nautical matters to know that bringing up a short-handed merchant-ship to an anchorage, in a gale of wind, is a difficult operation. Has it occurred to you that the increased rate of tide you speak of would render the operation more difficult and hazardous?—I think not, for she would bring up in it with great facility; the moment she came within the protection of the works, she would

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come to an anchor with great facility; I apprehend there would be plenty of well-protected room for her to bring up and come to an anchor.

747. It is through the anchorage you speak of the increased current that will be produced by narrowing the channel?—Yes; but still there would be sufficient protected space to bring up on; I do not think that would materially affect her.

748. It appears by the chart that the north entrance is very shoal, in some places only 11 or 12 feet. Supposing a ship to break adrift in a gale of wind from the southward and no escape out of the passage, must not she go ashore on some of the sand-banks?—The bottom is chalk, and it might be deepened by dredging to any reasonable depth.

749. Would not a ship breaking adrift when lying in the Downs be able to save herself by running into Ramsgate, or elsewhere?—Yes, she might.

750. Do you think the anchorage within the Brake can properly be called a harbour of refuge?—I think it might, and a most important one.

751. In answer to question 5960, in alluding to Trinity Bay, you say “it is a very difficult thing to predict precisely what effect your operations may have, not only on the Sand itself, but on the immediate neighbourhood;” does not the same doubt apply equally to the altered current by means of the work on the Brake?—Certainly not; because, in the one case, it is on so large a scale that it might be difficult to manage; but the work on the Brake I consider a very manageable subject, and with proper management I should not apprehend any danger of the kind alluded to.

752. How long will you take to execute the work, supposing it to be carried to the extent of five miles?—That is a question I should like to have time to consider before I answer it. It will depend in some measure upon the rate at which the shoal accumulates; as the artificial works of this should take place rapidly, a very few years would suffice.

753. In calculating the time it would take, what number of days would you allow, in the course of the year, for the interruption of your work?—I should think about one-third of the year must be allowed.

754. In the construction of the Plymouth Breakwater, the average of six years give 133 days of work, with the advantage of a harbour close at hand for the stone operations, would not that be too high an average to assume for working on the Brake?—I think not at all; for there are, in winter, many days on which they could work. In fact, by this very operation the sand would be set working for us; and I should rather like stormy weather, for by stirring up the sand below, it would enable it to work more efficiently.

755. You expect the sand will be forced up?—Yes. I look upon the stormy weather to be one of the most efficient means for performing the work itself; the artificial works being constructed during the summer, the remainder would go on all the year round.

756. Where would the vessels employed in bringing materials to the spot find shelter?—In Ramsgate Harbour; there is plenty of room for almost as many vessels as we should want.

757. From whence do you propose to get the hard rubble-stone?—That is a question I should like to take time to consider. All the details of the estimates, and the mode of construction, I should wish further to consider. It is perhaps sufficient, at present, to say that there are several places where it might be got; and the estimates are ample if the principle of the work be acceded to: I could soon prepare all the details.

758. Will not the vessels attending on your work be under a greater disadvantage than those at Plymouth, in consequence of Ramsgate being a tide harbour?—To a certain extent, that may be the case; but then as, by means of these works, there would not be the same assistance required, I think there would be much more advantage in favour of the work proceeding than in Plymouth.

759. You seem, in your Report to the trustees of Ramsgate Harbour, to infer that, as 38,257 sail have gone into Ramsgate in 30 years, that is evidence of the want of another harbour close to it, as you say there is no doubt that many vessels, in certain months, passed on for want of such a port; may this fact not tend to show that, if 1200 or 1400 sail enter Ramsgate, they are as many as have occasion to do so?—I think, if they had more accommodation, more would go in; for at present, in consequence of there not being sufficient accommodation in Ramsgate, particularly for large ships, they are obliged to lie in the Downs. For the purpose of providing for their accommodation, a very efficient work might be added to Ramsgate Harbour by making a new basin to the westward, having the entrance near the present new west pier-head, to have six feet at low water, which is the depth at the entrance; and by that means they could always take in a sufficient number of large vessels to be ready for sea, whenever the weather was favourable. That would be an important addition, and it would add materially to the effect of Ramsgate Harbour. Another defect is, that the surface of the inner basin or scouring reservoir, being only 11 acres, is too small to allow the effect of the sluices a sufficient time to operate, for the first effect is lost in 10 or 15 minutes after the doors are opened; whereas, if there was another basin to the westward of the present, of the capacity and depth I allude to for large ships, the scouring power will be doubled, and it would be a very valuable addition to Ramsgate Harbour; vessels of 18 or 20 feet might then come in, and always lie afloat. I do not know any place where such a work would be so valuable as that. It is an extremely difficult thing, on a coast like this, to get a harbour six feet deep at low water in spring-tides, with piers attached to the shore. Ramsgate has that at present, very nearly; and it might very easily be made so; and, with the addition of a dock of the same depth at low water as the entrance, large ships might come in and be kept afloat, and a very great public advantage would be the consequence.



760. (*Admiral Dundas.*) If you were desired to fix on a position, between the North Foreland and Portsmouth, for a harbour suitable for the following objects, namely, a harbour of refuge for the trade of the country from storms, a refuge from the pursuit of the enemy, and a proper place for a squadron of frigates and steamers, to afford protection to the trade of the country, and to carry on offensive and defensive operations, what place would you recommend as most favourable for all those objects?—That is a question I must take time to consider, as my instructions, in making this report, were confined specifically between the North and the South Foreland; indeed, more particularly to the Brake, and I had no opportunity of going beyond that.

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761. Do you think the anchorage within the Brake would be applicable to those purposes?—Certainly, for the mercantile navy, and for men-of-war too; but I am not prepared to say that it is decidedly the best that might be made, without further consideration. For the mercantile navy, nothing could be more appropriate. It strikes me that, if you take circumstances as they at present exist, and recollecting that the wind blows from the southward and westward for nine months out of the twelve, with which no vessels can go down Channel, and if it is strong they cannot keep the sea, and cannot get round the South Foreland, but are obliged to come to anchor in the Downs, and as (when the wind is easterly) they cannot get up the Channel, and the great bulk of the trade is from London,—taking all these circumstances into consideration, there is no place more applicable to the purpose than the Downs or the Brake in this quarter.

762. If you were not limited in the choice of a place for constructing a harbour, would you deem it expedient to spend the money in making a harbour within two miles of one already capable of giving shelter to 1500 ships in the course of the year?—Alluding to Ramsgate Harbour, I think Ramsgate Harbour, not being a low-water harbour, it is very desirable to have a low-water harbour as near as possible to it; for, in that case there would be an outer roadstead, so that in the event of any bad weather they could easily go into this harbour for the purpose of shelter; whereas, if the work was constructed without some harbour like Ramsgate opposite, I think it should be constructed in a different way. For repairs, and so on, if necessary, I think Ramsgate would have an additional recommendation; and, supposing it fit for the mercantile navy, it is only necessary to make it still more complete by an outer harbour, when all classes of vessels could run in at low water.

763. Should you prefer the proposed harbour within the Brake to a harbour constructed at Dover or at Dungeness?—A harbour at Dover is an extremely difficult subject. I have not been able to devote sufficient time to it, and that has never been officially brought before my notice, calling upon me to give an opinion upon it. There are very great difficulties in making a proper low-water harbour at Dover. I am not prepared, at this moment, to say that it cannot be done; but there are difficulties—first, in making it, and then in maintaining it; and before I could definitively commit myself, as to Dover, I should wish to have further time.

764. What do you say as to Dungeness?—Provided you do not attach your work to the shore, a very good harbour might be made there. Dungeness is a very peculiar position; and before you could attempt or think of constructing any work, either there or in the neighbourhood, you must ascertain the formation of Dungeness. It is a very curious geological phenomenon. You have a very low point or cape projecting many miles to the sea, between two very high forelands; Beachy Head on the one side, and the South Foreland on the other. The particular causes which have produced that in the first instance, and the causes still in operation to increase that, should be thoroughly investigated before any work was attempted there. I have my ideas (rather crude, perhaps,) upon that point; but when I answer the questions which have been proposed to me in detail, I may be able to state something more definite upon it if you require it.

765. When you surveyed the Brake, it was under the idea of a harbour of refuge being provided opposite to Ramsgate Harbour?—No; my instructions were to consider whether an efficient asylum harbour could be made on the Brake.

766. What depth is there in the North Channel at spring-tides?—The depths are stated in my Report. Taking it from the chart, I should say from 12 to 13 feet.

767. Without deepening the north passage into the intended harbour within the Brake, a ship could not enter at all times of the tide?—That depends upon her draught. Certainly vessels of any size could not come in at low water unless the entrance was deepened.

768. No vessel drawing more than 10 feet?—No, no vessel drawing more than 10 to 11 feet, certainly. In reference to that answer, I should wish to add that, by not commencing the works so soon, that is, commencing them to the southward, you would have a greater depth.

769. But still it would require deepening to admit ships of all sizes?—Not provided you carried the work sufficiently southward.

770. That is not according to this plan?—No, it would require a different place.

771. In case of hostilities, it would be necessary to have steamers of war ready at some prominent parts of the coast from which they could get out at all times of the wind and tide; do you consider the Brake Harbour, if made, a place likely to suit for that purpose?—I think the Brake might be made a very convenient place for that purpose; but, as I have already stated, my observations in planning this work upon the Brake were confined to that, and did not go beyond it, therefore I am not prepared to state whether there were other places more to the westward that would be better.

772. When you proposed that harbour, it was with reference to a harbour for merchant-



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ships?—My view was not confined to that, but the principal object suggested to me was a mercantile refuge harbour.

773. Nothing was said about a time of war?—No; but by extending the works southward, you might get any depth required.

774. Have the goodness to explain how carrying the proposed works further to the southward would increase the depth of water in the northern channels?—It would require a different arrangement altogether. If an allusion is made to this particular plan, there would be great difficulty in doing it; a different position altogether must be taken, and the work must be designed *de novo*.

775. It has been explained to you that the proposed harbour of refuge is to be accessible to merchant-vessels of the largest size, and to men-of-war steamers; will the place you propose to erect on the Brake afford the means of anchorage in the Little Downs?—I conceive it will.

776. For merchant-ships of the largest dimensions, and ships of war; as the entrance to the north of that harbour appears to have only 9 or 10 feet water, how do you propose to make a channel?—If you desire to have both entrances, you might deepen the northern entrance 4 or 5 feet by dredging; 18 feet at low water is hardly sufficient for those large vessels, but in the southern entrance you might have any depth you required.

777. There appears, at present, no navigable channel for large vessels, or vessels even of a moderate tonnage, at all times of the tide, to the northward and eastward of the proposed harbour inside the Brake; are you of opinion that such a channel could be formed and kept clear, and, if so, at what expense, and for what time?—To dredge 21 feet would be rather an expensive operation, but it is not an impracticable operation. With respect to the time for doing it, I wish for further time for answering that.

778. With reference to the changes which appear to have taken place in the position of the Brake-sand, do you consider it perfectly safe to found upon it either works for protection against the enemy or protection against storms?—I have no doubt it might be done safely. There is a work I should recommend the Commissioners to see, I have not seen it myself, but I have heard of it, at the mouth of a harbour on the coast of Holland, something similar, I understand, to that proposed here. It is a work of a very extensive nature, a work performed by means of timber and stone, and assisted by the operation of nature, so as to bring the current to the mouth of the Zuyder-zee, in front of the great canal which goes to Amsterdam, and forms a very important breakwater besides. I have heard of the work, and I have frequently proposed to go and see it, and I think it is very well worth the while of the Commissioners to inquire about it.

779. Are you of opinion that such a harbour as you have described may not be constructed in Dover Roads?—I have not had sufficient experience of Dover to form an opinion upon it; it is a very difficult subject. On the one hand, there would be a greater chance of keeping it open by making the work isolated, that is, open at each end, unconnected with the shore. On the other hand, provided, as there is reason to believe, that the progress of the beach depends not only upon the effect of the current but upon the waves combined with the current; presuming that, if a detached breakwater were made in front of Dover Roads, the beach would become sheltered, and the same means of preserving a free drift of beach along the shore would not be preserved. Now, as this is a question rather speculative, I should not wish to give a positive opinion.

780. Are you aware of any difficulty to the construction of such a harbour as that described to you in Dover Roads?—A work might be constructed, no doubt, but then the difficulty of preserving the depth, after you have got it, is a question which I should wish to have more time to consider before I answer it.

781. From the knowledge you have of the relative positions of the anchorage inside the Brake Sand and the Dover Roads, are you of opinion that there is a greater chance of the harbour filling up in Dover Roads than inside the Brake Sand?—As I stated before, my views have been confined to the space between the North and South Foreland, and I should wish therefore to decline giving an opinion upon that at present.

782. (*Lt.-Col. Alderson.*) In speaking of the materials for constructing a breakwater, you stated that stone and chalk, and iron and timber, might be used with advantage?—Yes.

783. In forming this estimate of 820,000*l.* per mile, was there any iron or timber?—A combination of all together, a certain portion of iron and timber, and stone and chalk.

784. You have alluded to the difficulties of constructing a breakwater at Dover, are those engineering difficulties to which you allude?—The difficulties are both engineering and geological, the principal geological; the engineering difficulties may be removed by a sum of money. I do not mean to say a proper harbour may not be constructed at Dover, but before I give an opinion upon it, I should wish to have time to consider it, if the Commissioners wish me to turn my attention to it. In my Report I have alluded to the position of Dover as a good position. The fact is, I have begun to consider it, and have gone back to the early history of Dover Harbour. I have made a commencement in the time of Henry VIII., and have got some very curious documents from the Cottonian Manuscripts, with drawings of all the different changes connected with it; and the history is very curious. Originally, from the facts we have, there was little or no mud in Dover Harbour, it was simply a bay formed in the chalk strata, and a small river coming in there; the Dour discharged itself at times, when it could, into the Channel; but in consequence of the prevalence of southerly and westerly winds, and the beach driving from the westward, a shingle bank was formed in front of the mouth of the river, so that the river, before it could get to the sea, was obliged to expand itself into a large lake; when



this lake got sufficiently full from the waters of the interior, and when the winds were not so strong without, it burst through its barrier, and forced itself into the sea. Thus the the shutting and opening of this basin soon occasioned, on the one side by the winds and waves from without, and on the other by the antagonist force of the waters from within, and the basin formed what is called Dover Harbour. Strangers looking at a position of that kind supposed that nothing more was requisite than to open the channel, and to confine it by works of art to preserve a proper harbour, but in proportion as those works were constructed the beach was increased, and the mud accumulated inside, and from hence has been the advance and receding in Dover Harbour.

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785. (*Lt.-Col. Colquhoun.*) In your evidence you have referred to the possibility of a work on the Goodwin, what is your opinion upon that?—A work may be formed, but it would be on so great a scale, that it would require so much time to determine on with accuracy that I am hardly prepared to give an answer at the present moment.

786. Do you think a work of small extent could be formed by way of experiment?—If you begin with the Goodwin, and alter the form of it by the works, some parts would fill up and others deepen, it would extend itself materially in different ways.

787. Apart from the consideration of affording protection to shipping, do you suppose that the work you propose could be used for the erection of a military work upon it?—I do not see why it should not.

[*The Witness withdrew.*]

Captain James Vetch, R.E., examined.

Capt. James Vetch,  
R.E.

788. (*Chairman.*) You are understood to have a plan for giving stability to sands, and thereby converting shifting sand into a shelter for any neighbouring anchorage?—Yes.

789. Will you have the goodness to give the Commissioners some explanation of your mode of effecting this object?—I believe the clearest way of explaining it will be to read an extract from my Memoir on the subject:—“The water of waves in approaching a shelving shore or sandbank obtains a progressive and accelerated motion against the shore, so that when the waves break they are enabled to carry up and deposit at the top of the inclined plane the coarser materials with which they are charged, but they bring down again the very fine sand and mud, these last being suspensible in agitated water from their small bulk compared to their surface.

“The action of waves, therefore, on a flat and low coast composed of loose and shifting materials, is to heap up all the coarser materials on the shore, or line of sustention; but a sandbank covered at high water presents no line of sustention to materials thrown up from the weather side, and these are consequently either carried off entirely, or swept over to the lee side, to be brought back again or shifted about by every change of wind; and the surface of a sandbank, therefore, not only is unable to sustain any accumulation of matter by storms, as the shore can, but is vulnerable on all sides. What then is clearly wanting to give storms and waves a constructive action on sandbanks, instead of the contrary, is to provide an axis or line of sustention, which work, for distinction's sake, may be called a spinal embankment, as enabling a sunken shoal, on that nucleus, to become an island, and also to distinguish it as a mere axis of accumulation, from those embankments, intended to surround or inclose a given space. Having drawn attention to the general conditions of sandbanks, the subject of the Goodwin Sands may now be proceeded upon in detail, and the measures proposed for converting them to a more useful account may now be described. To meet the condition of the Goodwin Sands, in constructing the spinal embankment, it is proposed to use iron rods, in a position nearly vertical, penetrating  $7\frac{1}{2}$  feet into the sands, and rising  $7\frac{1}{2}$  feet above their surface; the upright rods to be about one foot apart, and arranged in square frames of 12 feet each side; and these squares complete (called iron gabions for facility of description) will each contain 48 iron rods on a space of 12 feet square, penetrating the sand  $7\frac{1}{2}$  feet; and, considering what has been stated of the tenacity or closeness of the sands at that depth, it may safely be allowed that so great a number of prongs will give the gabion all the strength that can be required against any lateral force applied above the level of the sands; and, so far from seeking to go deeper for a foundation, it might be better to employ means to prevent any further settlement of the gabions. The iron gabion being fixed, and the rods inserted in the sand to the depth stated, it is next proposed to floor the interior space with hurdles, and on these to line the gabion with one row of fascines firmly fastened to the iron rods; and this first stage of the structure to remain without further addition until the action of the sea has heaped up the sand, externally and internally, to the top of the fascines, when a second floor of hurdles and second row of fascines will be introduced, and the operations continued until the gabion is filled. The gabions now described form but the first tier in the structure; and when the interior and exterior surface has become elevated seven feet, a second tier of gabions is to be keyed on to the first, and these last treated as the first. In the foregoing manner the author merely attempts to raise a barrier one foot high at a time, and composed of materials not offering a solid resistance to the waves, but calculated to receive and retain the sand on either side as thrown up. It will be obvious that, on such a surface as that of the Goodwin Sands, and where we cannot safely plant a heavy structure or acquire a solid foundation, we must endeavour to supply these deficiencies by embracing and holding on by as broad a surface as can conveniently and economically be attempted; and, with this principle in view, it is



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proposed (on the line of spinal embankment) to lay down two parallel rows of gabions, 36 feet apart, bonded and tied together with cross rows at every 36 feet, by which means a base, 60 feet wide, would be procured for the spinal embankment; and, by the numerous cells of which it is composed, every facility would be offered for the accumulation and retention of sand, &c.; an object which would be still further attained by throwing out ribs from the spine, at suitable points, to intercept the passing sedimentary materials; and these ribs, embracing the sand to a still greater extent of surface, would increase the stability of the spine."

790. Looking at the cross section, is the whole of this space supposed to be filled with fascines?—No. There are four continuous parallel rows of iron rods lined with fascines one foot in thickness each, and the intervals between these parallel walls are supposed to be filled up with drifted sand.

791. So that, when this is completed, it will become a kind of solid body, composed of sand, iron, and fascines and hurdles?—Yes.

792. It is a wall, composed of iron rods and fascines and hurdles, 12 feet in thickness on each side, at the distance of 36 feet in the clear, with cross walls of the same material, leaving, therefore, a large square of 36 feet, which you suppose will be filled by the accumulation of sand?—Yes. I should prefer to use a quantity of seaweed between the layers of hurdles, if it could be procured cheap enough. I have seen some quite sound which has been laid down for 40 years, and if it could be got cheap enough, I have no doubt it would accumulate the sand more than anything else.

793. What do they use in Holland?—I understand seaweed is extensively used. In Wexford Harbour the seaweed has been much applied for embankments.

794. In that way you propose enclosing a large quantity of the Goodwin Sand; for what purpose?—For the purpose of preventing currents passing over the surface of the sands, either laterally or longitudinally; the great danger to shipping is from the indraught by the lateral passage of currents across. Whenever two channels are presented to a stream, one much larger and deeper than the other, the level of the two streams will vary at different times of the tide, and then there will be a current, from the higher to the lower, across any intervening bank as soon as the tide overflows it and establishes a connexion.

795. The object is to prevent the passage of currents across the Goodwin Sands?—I believe the moveability of those sand-banks arises from the immense surface over which the tides and waves now pass; that if they are prevented passing over the surface the effect of carrying away the material of which the bank is composed would cease; and I believe, from all I have been able to ascertain, the bank has increased in height, and would increase still further but for the great friction and agitation between the level of high and low-water marks.

796. So that, by carrying a screen or screens across the Goodwin Sands, which you propose, an accumulation of sand would take place on both sides of them?—On the weather side I believe it would be thrown up, and on the lee side it would be deposited.

797. Supposing the Goodwin was converted into an island by your plan, that would prevent the tide spreading over a surface of about 8000 acres?—Yes, about that quantity.

798. And force it into the Channel between the Goodwin Island, as it may be called, and the coast of Kent?—Yes; a small portion of it.

799. What increased velocity of the tide do you suppose this would occasion?—It would be difficult to offer any very definite opinion upon that point. There is no doubt an increase would take place; but, from the great width of the Channel between the French and the English coast, it would be difficult for a mathematician to give a definite answer of the small increase due to the inner channel, the velocity would not, I consider, be increased above four per cent. on the whole body of water passing between the Goodwin Sands and the Kentish shore.

800. If this plan should be carried into effect, do you contemplate a harbour on the Goodwin?—No; the conversion of the Goodwin Sand into an island would merely afford shelter on the lee side, and would make the Great Downs a more sheltered anchorage; and the sands would cease to be dangerous to shipping.

801. Supposing in war a fleet of large ships were called to act in the neighbourhood of the Downs for hostile operations, and it was considered necessary to anchor within the Downs, would not the increased rate of tide be felt very seriously to their disadvantage when blowing a gale of wind from the south, and a heavy sea?—I should not apprehend that the increase of the current would be so great as to create the mischief of making the riding materially different.

802. You speak of the advantage of this increased tide in deepening the Gull Stream and removing some of the other shoals, as this will carry away an immense quantity of sand and mud, where will it be likely to deposit itself?—In the nearest tranquil place, particularly in Trinity Bay.

803. What other tranquil place would be the most likely?—I do not know of any other tranquil place near at hand.

804. Do you apprehend it would occasion any shoaling of the water at the mouth of the Thames?—I should apprehend it could have no effect in the estuary of the Thames.

805. Not in carrying away the sand towards the mouth of the Thames?—I conceive the drift of sand and mud is in an opposite direction. It appears to me that if that project were carried into effect, the sand-bank itself of the Goodwin would present a tranquil surface of deposition greater than any other that now exists; it presents an extent of 8000 acres for a deposit to take place on, for a depth of 12 or 15 feet, in places besides



Trinity Bay, which has now seven, eight, and nine fathoms of water, the surface of the Goodwin Sand itself and Trinity Bay would then afford ample room and facility for deposition for centuries.

806. When Trinity Bay fills up, it must seek some other place of repose?—Then I apprehend it would pass down Channel, to the Ridge and Varne banks, or north to the Falls, and the Kentish Knock.

807. On the flood-tide through the Gulls where would it be carried?—The last two hours of flood, I think, is nearly to the north.

808. On the tide going through the Gulls, where would the sand be likely to deposit?—If it went in that direction, a likely place would be along the north side of the Margate Sands; but the Gull Channel shoals to the northward, deepens to south, and the inference is against the matter travelling up hill.

809. Is it in connexion with the work on the Goodwin that you contemplate carrying on an embankment from Ramsgate across the Sandwich Flats?—It may be taken in connexion with the Goodwin Sands or not. I conceive that the embankment along the Sandwich Flats would have the means of accelerating the current between the Brake-bank and the shore, and clearing Ramsgate Road and the Small Downs.

810. Is there any object in this embankment except reclaiming a large quantity of land; has it any reference to better accommodation for the shipping?—I have no doubt, as far as I am able to form an opinion, that it would very much improve the Channel between the Kentish shore and the Brake-bank, and also that the discharge of the river Stour through Ramsgate Harbour would effect several beneficial objects.

811. As this embankment and the converting the Goodwin into an island must produce a great and extraordinary effect on the tides, can you, with any confidence, say what that effect would be?—I should merely expect that the channels would be cleaner and deeper, but what the increased rate of the current would be I could not venture to offer a definite opinion. I do not apprehend any material increase to the velocity of the tide streams from these works; but the streams being confined between elevated banks, a more direct and fixed channel will be obtained by them; and by the same works they will be preserved from being diverted and dissipated by cross currents and gales of wind, which last after a long continuance have been known to drift the margin of the Gulf Stream many miles.

812. Any mischief once done by altering the direction of the tides by works of so great and prominent a nature could not be easily remedied?—It appears to me that the mischief which is now doing arises from the instability of these banks, and that if they were rendered fixed and stable, the mischief which now exists would cease to exist.

813. (*Mr. Walker.*) Do you think it satisfactorily proved that the Goodwin Sand, at the depth of seven and a half feet, is so firm as to be almost impenetrable?—We have the evidence of Mr. Smeaton and Captain Hewett; and Captain Bullock has informed me that he had been able to penetrate only to seven feet; the spar he has erected in the bank has only sunk to the depth of seven feet in three years; and from all these circumstances at different places and by different observers, I am inclined to form an opinion that the general state of the bank is such as to offer a great resistance at that depth.

814. You found your proposition upon the authority of those different reports?—I have done so, but I must beg leave to explain, that if it should be found that the Sands are penetrable in places to a much greater depth, that would not affect the practicability of the scheme.

815. Do you think that the sand would be found to have the same denseness throughout so as to occasion the pressure of the gabions sinking some lower than the others?—In that case it would be very easy to have the perpendicular rods made of a greater length, and to take a deeper bearing for the gabions.

816. As you ascertained any greater yielding of the sands, so you would act?—Yes.

817. (*Chairman.*) Suppose, as an experiment, Government were disposed to sanction a trial of your plan on some sand at a moderate expense, say about 3000*l.*, how many yards could you accomplish for that sum?—I have formed an estimate that it might be accomplished for about 24*l.* per lineal yard supposing the rods to penetrate seven feet and a half; the whole breadth is 60 feet.

818. Do you know of any sand which you could operate on for that sum in a situation, that if it answered it would be found a useful protection, for instance, the Smithwick bank off Burlington Bay?—The Smithwick bank is covered from two to four fathoms constantly with water, and therefore it would be a more expensive work than on a bank which was dry at low water.

819. Can you suggest any other sand where it might be tried?—The most easy bank near at hand is that at Margate, but how far that might be useful I must leave to naval gentlemen to judge. I should prefer some part of the Scroby Sand off Yarmouth.

820. If it is not carried out to its full extent the expense would be thrown away?—On the Scroby Sands the tide is only six feet, therefore, though constantly under water, the expense there would not be great for a trial.

821. Would you consider that making one of those squares of 60 feet would be a fair experiment for your scheme?—I should say not as an embankment on the Goodwin Sand.

822. Might it not be used as a foundation for a beacon?—I think that might be very usefully done, and is what has often occurred to me.

823. Suppose a sufficient quantity of work on your plan, say 60 feet square, to be put down for a beacon, what would be the probable expense?—On a rough calculation, I should say about 600*l.*

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824. Since you have withdrawn from the Queen's service, have you occupied yourself as a civil engineer?—I have.

825. Have you been engaged in any harbour works?—I have had to examine and report on several harbours on the south and east of Ireland from Wexford round to Dungarvon.

826. Do you know anything of Dover?—I have paid some attention to that port. I was down there last October, and examined it, and formed some opinions respecting it.

827. Will you have the goodness to state the result of your observations?—Since I received notice yesterday afternoon, I have put together some remarks, and in reference to the Commissioner's Report in 1840, I observe, "The proposed harbour for Dover fronts the south-east with a pier about 2400 yards long, the average length and breadth of the harbour being 2000 yards by 1000, and therefore containing about 400 acres; the west wing projects about 330 yards from Cheeseman's Head, and the east wing projects seaward about 800 yards from the shore. The outer half of the proposed harbour has from four to six fathoms water, and the inner half shoals gradually from four fathoms to the beach. The bay of Dover is but a slight indent of the land, and in its natural state gives no shelter (in the deep-water anchorage) from any quarter except the north, that is directly from the shore. It is to be regretted that nature has not presented more facilities for the construction of a large harbour at Dover, as it is well situated for a War Port both for offence and defence; but to render it efficient for all purposes, every part of the construction must be executed by force or art at great labour and expense, (it is fairly taking the bull by the horns,) and when completed, no engineer could venture to say how long an anchorage enclosed by solid walls in that locality could remain open and available, as every analogy leads to the belief that such a piece of water rendered tranquil would readily fill up with sand and mud. The valley in which the town of Dover is situated by means of its brook discharges the surface water (from a space of about 20 square miles into the bay, together with the sillage and silt which the rains can bring down), and this, in the course of 12 months, must be considerable; this matter, held in suspension, passes through the Pent and present harbour, and is discharged from thence into an agitated sea; but if the bay be enclosed, and the agitation of the water be stilled, the matter brought down in suspension would no longer be diffused in an agitated sea, but would be deposited and retained in the proposed port. Again, it is notorious the tide currents along shore from Folkestone to Walmer Castle carry a great deal of silt constantly in suspension, as may readily be seen from the colour of the water; this silt or slime which is no doubt derived from the constant friction of the waves against the chalk cliffs and shores, is now carried to and fro along the coast; but in the event of enclosing Dover Bay, and producing still water there, the matter held in suspension would then speedily deposit, as occurred at Ramsgate Harbour as soon as the elbows of the piers were in progress of construction. At present the current of tide flows rapidly past Cheeseman's Head, but when the west wing of the proposed harbour is made to project 330 yards further into the stream, the current will be found more rapid, and be able to carry more matter in suspension, which will enter readily (in passing) through the mouth of the harbour and settle inside. It will be proper also to consider the effect of a rapid stream passing along the south front of the harbour as affecting the ingress and egress of vessels working through narrow entrances. I should beg particularly to call the attention of the Commission to the probability of a close harbour at Dover silting up. Mr. Smeaton found, in 1774, at Ramsgate, that 268,700 cubic yards had then been deposited in eight years, and that the accumulation was taking place at the rate of one-fifth of an inch per week. In 1841 Mr. Wm. Walker reports to the British Association that since the construction of the Breakwater at Plymouth, the depth of water over the works near the Citadel was diminishing from the accumulation of sand and mud, and was creating an anchorage where only rocks previously existed, and this it may be observed where there is a strong backwater. This may be an advantage if the process would cease when required. General Pasley found the interior of the Royal George silted up 29 feet, though externally there was little or no accumulation, and all these depositions simply arising from still water being procured. In our own time we have the example of Howth Harbour filling up to an enormous degree. In the evidence on the Shipwreck Committee I perceive a threshold or sill 12 feet high has been proposed to the entrance to the proposed harbour at Dover, for the purpose of preventing the shingle from entering by the sill, but the silt, being in suspension, would meet little obstruction in entering; and when once deposited inside, would be retained there. Another great difficulty at Dover is the quantity of shingle travelling along the shore, and which has repeatedly blocked up the entrance of the present harbour, a result, no doubt, aided by the removal of part of the pier at Cheeseman's Head; and what with the removal of a pier at the west horn of the bay, and the construction of one at the east horn, the frontagers have managed to gain a considerable slip of land at the cost of filling up the bay to the same extent; but if the pier at Cheeseman's Head was restored, and the Castle Jetty removed, the sea would claim its own again, and the entrance to the present harbour might be preserved. From the prevalence of south-westerly winds, and from the more violent storms coming from that quarter, the drift of the shingle at the end of a year is very considerable to the east; and a pier projecting from the shore near Cheeseman's Head must intercept the shingle in its north easterly course, and prevent its entering the bay; but against such a pier the shingle will accumulate on the west side, and will then form a beach gradually stretching out to sea parallel to the pier until it arrives at the extremity, when it will commence to pass round and travel north-eastward, as before; the shingle forms a zone or belt from high-water mark to low, and I believe it only travels



on that zone; but against a projecting perpendicular pier it will, in process of time, create a zone or belt of its own, which will become a way for its future career eastward; at the same time it must be allowed that a pier 330 yards long, and projecting into water eight fathoms deep, would present a barrier to the drift of the shingle for many years; nevertheless to those who have observed the accumulation on the west side of Falkestone Harbour such danger must not be overlooked (as one of a very remote date), but that date will be brought very near at hand indeed if the face of the pier, instead of being nearly perpendicular, it presents a long slope to sea of four or five to one; in such a case the road for the shingle to travel upon would be already formed, and it might pass along in a comparatively short space of time. The great difficulty at Dover is to procure a scour of tide stream through the proposed harbour to prevent the deposition of mud and fine sand, and at the same time to procure shelter and prevent the entrance of shingle coming in; these two circumstances requiring opposite remedies. Large openings or entrances to the harbour at the west and east ends might procure a stream over the anchorage ground, but the same would become more exposed, and the shingle would drift in; on the other hand, if there are no entrances at the west and the east wings of the harbour, the silt would settle in greater abundance, and between the two evils and conditions it is difficult to choose. The great question, if the harbour is resolved upon at Dover, is, by what kind of piers it should be enclosed; these must necessarily arise out of deep water, and if nearly perpendicular or at a steeper slope than  $45^\circ$ , there can be no breaking sea upon the pier, as at Plymouth Sound and Kingstown, and all damage from progressing and breaking waves may be avoided by such an arrangement; if, on the other hand, the slopes to seaward are four to one, as proposed, they will evidently bring on a destructive breaking sea without any necessity, and, as I have said before, such a disposition would form a road for the shingle to travel upon to the entrances of the harbour, and to block them up. The above are no matters of opinion, they are physical laws that have been acknowledged from the time of Sir Isaac Newton to the present, as shown by the writings of Playfair, Bremondier, Webster, Scott, Russell, and others. A wave will only break in shallow water; and if no shoal or shelving sea-wall is presented, there will be no breaker or progressive motion in the waters of the waves, the undulation of the sea will only rise and fall against a perpendicular or highly inclined wall and recoil, and vessels will rather be repelled than driven against such a pier; but the contrary will happen wherever there are breakers. Besides the two great evils of a long slope to seaward of the piers proposed for Dover Harbour, I should object to the deposit of such an immense quantity of loose material in a strong tide-way exposed to the winds and waves from three quarters of the compass, as, if such piers got breached, the dispersion of such a mass of loose stones would be a serious mischief. I think much credit is due to Mr. Cubitt for the ingenuity of the form of the caissons he proposes to lay down as the nucleus of his breakwater; and these caissons of a triangular section present a slope of  $60^\circ$  to the sea, and avoid all danger of creating breakers; but constructing them of a perishable material, he finds it necessary to protect them by long slopes of loose stones. I should therefore suggest that if these caissons were constructed of plates of malleable iron, fixed on cast-iron frames, and filled with the best concrete, they would effect the object in less time, at less cost, and the two great evils and the one great danger might be thus avoided. If a platform is requisite, two lines of such caissons may be laid down close together, and the interval filled with concrete. (See Diagram.) Mr. Cubitt's section of pier occupies a base of 372 feet wide with 40 feet of platform; that proposed to be substituted has 130 feet of base, and 62 feet platform. Some iron boats at the end of forty years have had no perceptible decay of the iron in their bottoms; and mooring-chains, taken up in Dublin Bay, after being forty years immersed, have been found uninjured. It is alleged that the iron boats are preserved by their motion through the water; but it is the same thing whether the surface of the iron passes through the water, or whether the water passes over the surface of the iron; and at Dover there will be no lack of agitation of the wave against the plates; and any internal decay or decomposition of the iron will form a strong cement to the concrete, investing it with the character of a rock, as has often been observed in analogous cases. Harbours may be divided into three classes: first, backwater harbours, as Portsmouth, Plymouth, &c.; second, channel harbours, as Spithead, the Motherbank; thirdly, close harbours, as Kingstown, Howth, &c.; the first are often incommoded with bars; the third are liable to silt up; and the second, having a thorough tide-way, are the best for all purposes." I beg to refer to one or two opinions in corroboration of my statement. Mr. Smeaton says, "A large mass of silt, partly composed of mud, but chiefly of very fine sand, has been brought into the harbour (Ramsgate) by the tide; this is the natural tendency of all harbours; a deposition and increase must take place unless there are powers either natural or artificial to produce a contrary effect." In respect of waves, in "The Transactions of the British Association," Mr. Scott Russell says, "That in an experiment it was observed that every wave broke exactly when its height above the antecedent hollow was equal to the depth of water. That waves of the sea, when they approach the shore or come into shallow water, become waves of translation, and obeying the laws already mentioned, always break when the depth of water is not greater than their height above the level."

828. Do you know Kingstown Harbour?—I have been there frequently.

829. Are you able to inform the Commissioners whether there is any silting up in that harbour?—I did not observe any at the time, but I think it is a harbour not so likely to silt up for a long time; there is no current passing in front of it and carrying matters in suspension along with it.

830. (*Admiral Dundas.*) If you were desired to fix on a position between the North Fore-

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land and Portsmouth for a harbour suitable for the following objects, namely, a harbour of refuge for the trade of the country from storms, refuge from the pursuit of an enemy, and a proper place for a squadron of frigates and steamers to give protection to the trade, and carry on offensive and defensive operations, what place would you recommend as most favourable for all those objects?—I have come to a strong opinion that the Downs would be the most appropriate and most practicable locality for the formation of such a harbour.

831. The whole stretch of the Downs?—The space I have enclosed by breakwaters, &c., on the chart.

832. You are keeping in mind that it is intended for vessels of war carrying on operations, hostile or defensive, and giving protection to trade?—I see little difficulty in obtaining defences to protect the entrances to a harbour in that locality; the great recommendation to the Downs, I think, is, the possibility of acquiring a thorough tide-way through it, to keep the channel clean.

833. Do you mean if your work is carried on on the Goodwin?—I am alluding to works on the Brake and vicinity at present.

834. You give a warning against enclosing an anchoring-ground, in consequence of the possibility of its silting up, would not that be prevented by a flush-tide passing in and out of the two openings, and the bottom being kept in a constant state of disturbance by anchoring and weighing anchor?—If the harbour is provided with two openings, and there is a tide-way through those openings, I think it would prevent the deposition of silt.

835. (*Chairman.*) Does not the fact of there being little or no accumulation round the Royal George show that where there is an action of the tide the accumulation is not great?—Precisely so. The space outside was kept clear by a current, and the space inside, being tranquil, silted up.

836. In alluding, as you do, to Howth Harbour filling up, can you give any statement of the cause of that?—I observed Howth Harbour about four years ago, and have now particularly alluded to it as a prominent example of anchorages silting up when they are entirely enclosed and rendered quite tranquil, which promotes the deposition of mud and fine sand brought in by the tides. The deposition in Howth Harbour was excessive, and it is probable there are some powerful local causes which accelerate the process; but these I did not investigate.

837. Do you suppose that if a harbour were to be constructed in Dover Bay, the front of it running along in seven fathoms of water, and the west end not open, it would be liable to any accumulation of the shingle?—If the walls be perpendicular, I do not think there will be any danger in that case from the shingle.

838. Do you think that with two openings at Dover, and the ebb-tide running out at the bottom of it, if the bottom is kept in a constant state of disturbance, there will be much danger of the inconvenience of accumulation?—I should beg to say, that if one of the entrances fronted the west, and the other the east, there would be very little danger of the silt, if the tide current were permitted to pass through; but that I do not expect that the casting and weighing anchor, or raking up, would have much effect in removing the silt; it was tried at Ramsgate to stir up the mud by machinery, but it was found very ineffectual; without the aid of a current, the matter would deposit again in the same place.

839. The harbour at Howth has been abandoned almost since the harbour of Kingstown has been constructed?—It has nearly.

840. Do not you think that the filling up has been in a great measure in consequence of that?—I think it has very much answered the description Smeaton has given of Ramsgate Harbour, that without taking artificial means of procuring a back-water, Ramsgate will be filled up in the same manner; and that without some artificial means of back-water at Howth, that will be filled up.

841. You have said that you have a strong opinion as to the place at which you should prefer a harbour of refuge, be good enough to favour the Commissioners with your reasons for preferring the Downs for such a harbour, and in what part of the Downs you propose to erect it?—I refer to the Little Downs, as shown by the plan. In the first place, it is a good anchorage-ground; it is well situated for vessels bound to and from the river, when detained by contrary winds; and by some engineering improvements, I conceive the Channel might be greatly cleaned and deepened, and become much more valuable as a haven than it is at present.

842. You have said that the anchorage within the Brake, if it became deeper, would be very convenient for trade; but, taking it in its present state, is there sufficient depth of water for frigates and ships drawing 21 feet?—I think, without improvement, it would be hardly sufficient; but with the shelter I propose, the expanse of deep water would be ample.

843. Would not a harbour at Dover be as good as the Downs for vessels outward and homeward bound, supposing the anchorage as good?—The harbour at Dover appears the best for warlike purposes; and though I am hardly navigator enough to speak to the facility of getting in and out at an entrance 700 feet wide, I have a strong impression that fleets of wind-bound merchant-men and convoys would find it very inconvenient as compared to a harbour at the Small Downs with an entrance one mile wide.

844. The question refers to its position?—I think the harbour at Dover is most convenient for ships-of-war.

845. (*Sir Howard Douglas.*) In answer to a former question, when you were asked which would be the best for hostile operations, offensive or defensive, you said the Downs; but you now say that, for war purposes, Dover would be the best?—I did not mean to say that it would be the best for warlike purposes, I understood for every purpose, including those,



of course. I would beg to explain, that in giving a preference to the Downs over Dover, I imagine we should secure a constant tidal stream through it, and the harbour would be preserved of such a depth, that at Dover no such tidal stream can be reckoned on; and that while the one was constantly open, the other would run a great chance of being silted up.

846. If you keep it open for the tide to run through, the shingle would get in?—Yes; at Dover it would, and if it were shut up, silt would deposit; and it would be therefore a very precarious work to lay out money on.

847. Which, for military purposes, would be the best harbour for steamers to lie for the protection of the trade?—I should consider Dover.

848. Do you consider that a length of 60 feet of your work, which would be only one square, would afford a sufficient experiment?—If it was placed on some most prominent point, the apex of some of the little spots now left dry, it might be preserved from any swash-ways. It requires the selection of some spot which would appear to form the apex of a sort of hill, and the extreme south or north end would probably answer best if placed on the Goodwin.

849. (*Lt.-Col. Colquhoun.*) From what you know of Dover, do you think that any scouring operations can be brought into the proposed new harbour, to assist in keeping it from silting up?—I do not think there could be to a useful extent.

850. You do not think that water could be brought down by sluices, to assist the tide out?—The quantity of water brought down from the Pent now appears insufficient to keep the mouth clear. Any back-water would be too small to have any effect upon a harbour of 400 acres of surface.

851. If anything could be done to give greater activity to the water inside, would not that tend to preserve it from silting?—I do not think that any back-water could be procured to a sufficient amount.

852. (*Sir Henry Pelly.*) When you spoke of deepening the part within the Brake, did you mean the harbour part or the mere entrance?—The northern entrance. I believe there is considerable obstruction nearly opposite Ramsgate from certain chalk shoals, and I think by dredging channels through them a deep scour would take place through the opening, which would serve to keep the entrance and anchorage clean.

853. Are there many parts of the proposed harbour in which there are six fathoms of water?—About 170 acres near the main entrance.

854. The great thing is to get an outlet; you think that might be got by removing the impediments which now make the channel so shallow?—That is my opinion; I think a north entrance might be obtained by dredging and ploughing. The main entrance is a mile wide and from six to seven fathoms deep.

855. In your plan you appear to propose embanking the Sandwich Flats; would there be any difficulty in that?—I am of opinion that by embanking the Sandwich Flats, there would be sufficient gained to pay the expense of effecting it. The soil is so rich that I have seen it carted away as manure for the land near Pegwell.

856. (*Capt. Washington.*) With respect to Dover, supposing Mr. Cubitt's plan carried out at Dover, would it not be an improvement to turn the brook which flows into Dover Harbour to the westward of Cheeseman's Head?—That is a measure which might be useful to prevent the silt depositing, but I fear the shingle would soon close up the passage again.

857. You speak of the fear of silt; do you think this more likely to silt up again with one central entrance or with two entrances?—The great thing to keep it clear of silt would be a western and eastern entrance; but in that case, a large western opening would let in the shingle and expose the anchorage.

858. (*Mr Walker.*) In speaking of Dover Harbour and its back-water, do you refer to it as it now is, or before the late improvements were made?—The proposed harbour will occupy about 400 acres, and I do not see the possibility of constructing any scouring basin of a sufficient size to effect that, without an immense expense. If the whole pent and outer harbour were now made into a scouring basin, and the gates removed to the entrance of the present harbour, I do not think even that quantity of water would be sufficient to make much impression.

859. You say you have not the means of forming a back-water?—No; the proposed harbour is backed by buildings and high grounds so much that it cannot be done on an effective scale.

860. Is there any possibility of stirring it up from the bottom by harrows, and so on, so as to carry it off?—I fear not to an important extent.

[*The Witness withdrew.*]

Adjourned till to-morrow, at 12 o'clock.

Friday, 10th May, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Sir Henry De la Beche, examined.

861. (*Chairman.*) Are you acting as geologist in connexion with the Ordnance Survey?—I am director of the Ordnance Geological Survey of Great Britain.

862. As it is well known that the shingle on the southern coast of England generally travels from west to east, have the goodness to state what would be the effect of having a

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western entrance from the shore, disconnecting the breakwater, as in Plan No. 1, or in seven fathoms water, as in Plan No. 2, in front of Dover, or any place where a tide-harbour now exists?—The shingle would, in Plan No. 1, travel along the shore, as it now does, without any such breakwater. If it be a vertical wall in Plan No. 2, then the effect would be to accumulate the drifting of the beach between the shore and the point of wall A. precisely in the manner of any other spur-wall or jetty, the shingles falling into deeper water than the common line of low water, and there accumulating at a certain angle; consequently, the whole of that corner would tend to be filled up by the drifted shingle. After a sufficient accumulation had taken place to advance the bank of shingle, the next effect would be for the shingle to be forced on in the direction of A. B., and it would accumulate beneath the line of low water. The constant drift of shingle from the west, and the constant action of the breakers, would form an addition to the bank A. C.; so that eventually (but it would be a long time before that could happen) there would be a tendency to allow some shingle to come across, and to be gradually accumulated in that direction.

863. Can the deposition of small sand and silt be prevented in the construction of any harbour of refuge, by which a roadstead, which is now exposed to a strong current, is made comparatively still water?—I apprehend that the silt, or other small detritus, mechanically suspended in water by the motion of that water, or forced forwards on the bottom by the current, must be deposited in all situations where the necessary motion to keep it suspended, or the friction to propel it onwards ceases.

864. If these two openings, C. and B., are preserved in the centre and at the east end, A. being closed, would the tide be sufficient to carry off and prevent that deposition of silt and mud?—During heavy gales of wind the minor sediments at the bottom, in seven fathoms water, could scarcely avoid being stirred up by the action of the waves; and the water, with this sediment mechanically suspended in it, entering into the body of the harbour, the silt and mud would be deposited when the necessary motion for keeping them suspended should cease. I apprehend that channels only would be kept comparatively deep in the line of the current of the tides; but I should conceive that the accumulation would, under the conditions before me, be slow, provided the tidal waters be not usually much charged with detritus in mechanical suspension, or much silt and mud be not forced in, by friction on the bottom, at the flood tide.

865. Supposing that gradual slow accumulation to go on, if it is kept in a constant state of disturbance by anything like an iron harrow, or anything that may be invented for the purpose, do you think that would keep the harbour free from accumulation of mud?—To a great extent it would, provided the tidal currents had sufficient velocity to carry off the mud, silt, or sand thus caused to be mechanically suspended in the water. If this were not the case, the matters mechanically suspended for the time would again come to rest when the disturbing cause should cease.

866. You do not anticipate any great sedimentary deposit, during heavy gales of wind, in addition to the usual drift of detritus along the coast?—From observation I should say that from a depth of about 15 fathoms the water becomes discoloured by the admixture of detritus during heavy gales of wind. In all cases, anything like a harbour of this kind can be considered as nothing else than an artificial cove, and therefore it is but reasonable to expect that sedimentary deposits must take place from the usual causes.

867. You think that if the harbour is kept in a constant state of disturbance there is no danger of its being lost?—Although sedimentary matter would probably be deposited, still that sedimentary matter would to a great extent be removed by the process described, provided, as previously stated, the currents could carry it off.

868. (*Lt.-Col. Alderson.*) Are you of opinion that if a breakwater, with an exterior slope of four to one, or about 15 degrees, were constructed in front of Dover, the shingle would travel on as it does on the beach, and deposit itself on the slope between high and low-water mark, that breakwater being carried out in seven fathoms water, and thus find its way to the entrance of the harbour?—I should apprehend that upon any breakwater having a slope upon which shingle can rest, if such breakwater be connected with the land, shingle would travel upon it in like manner as it does in the front of rocky shores, where between the beach, properly so called, and low water, there are often sloping beds of rock. By rest, I mean where it can remain at rest notwithstanding the action of breakers. If the crest of the breakwater be not sufficiently high to prevent the shingle being forced over, it will be so forced over, and accumulate on the other side of the breakwater. I also apprehend that in the deeper water shingle would creep on to a certain extent with its progress between high and low-water mark.

869. If so, would not this be prevented by making the exterior slope of the breakwater a slope of 45 degrees or more with the horizon?—Certainly; but probably a much less slope, one which will not retain the shingles upon it, will be sufficient to counteract the presumed effects previously noticed.

870. (*Lieut.-Col. Colquhoun.*) From your knowledge of the southern coast of England, and the movement of the shingle, do you think its progress eastward can by any means be arrested?—As much of the portions of rock, from which the shingle is formed, is usually broken or dropped from cliffs in various places along the shore, and the shingle is only stopped from time to time by headlands projecting into deep water, beaches have local characters, according to the kind of pebbles of which they are composed, such characters being of any variable extent according to circumstances. From distance to distance, sometimes considerable, beaches are often now locally arrested, not readily passing round some headlands, the drifted shingle there accumulating in the deep water. You could only



arrest, to a very limited extent, the progress of such shingle in these distances; for if the supply be greater than your means of stoppage, it must necessarily accumulate and pass on.

871. Of the two plans, No. 1, with open entrances between the land and the break-water, and No. 2, an enclosed harbour, with two entrances, in seven fathoms, which would be best preserved from the accumulation of shingle and the deposition of silt and detritus within the enclosure?—The plan No. 1, without reference to the tide-harbour.

872. Are you of opinion that it is desirable to have a double entrance or only one entrance?—If you were to close up all except the centre, the sediment would accumulate to a much greater extent, inasmuch as the power of removal would be decreased.

873. If the bottom is kept in a constant state of disturbance, do you apprehend there is any reasonable objection to constructing a harbour on this plan arising from any apprehension of its filling up?—Although accumulations would take place if such a plan were adopted, and you could stir up and mechanically suspend a certain amount of detritus which is borne into it, such accumulation would be small comparatively with that which would take place if no such extraordinary measures were adopted, it being always understood that the tidal current be sufficient to carry out the mud and silt thus caused artificially to be suspended in the water.

874. You are of opinion that a harbour of this description might be constructed without any apprehension of inconvenience from deposit?—To a certain extent, under the conditions previously mentioned; at the same time it would be a tremendous labour efficiently to stir up the sediment.

875. What would be the effect of a sill filling up the space between the bars 12 feet above the bottom?—I should apprehend that as the detritus would be carried into such a basin as that I see before me, in two ways; first, by the action of the waves causing it to be mechanically suspended in water; and secondly, by the current entering in and forcing the bottom along by friction; such a bar would not prevent the entrance of the greater portion of the mud, silt, and sand mechanically suspended in the first case, though it might arrest the progress of the sedimentary substances propelled by friction along the bottom until a fitting slope be formed in the second, provided that the action of the current of the flood tide would not so disturb the water as by its increased motion to cause the silt forced against the bar to be mechanically suspended and driven on; being once in, it cannot escape.

876. The effect would be to retain the mud to form a shoal?—Yes.

[*The Witness withdrew.*]

Adjourned.

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## RAMSGATE.

*Tuesday, May 14th, 1844.*

Admiral Sir T. BYAM MARTIN, in the Chair.

*Kennett B. Martin*, Harbour Master, examined.

Mr. *Kennett B. Martin.*

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877. (*Chairman.*) You are harbour master of Ramsgate?—Yes.

878. How long have you been in that office?—I have been harbour master and deputy master 53 years.

879. How many trustees are there?—I believe there are 200, but I am not quite certain as to that.

880. Must there be that number, as the Act says there shall be?—I believe so.

881. How are they filled up, by election?—They are.

882. Do any of them reside on the spot?—Sir William Curteis is the only one residing here, and he does so only part of the year.

883. How often do the trustees attend personally to examine the harbour?—Once a-year; and sometimes they come on visits of inspection perhaps two or three times a-year.

884. Who looks after the harbour on the spot?—The deputy chairman, when here, and the harbour master.

885. Do you hold your appointment from the trustees?—Yes, I do.

886. The harbour has been in the course of improvement since the Act of 1815?—Since ever I can recollect it has always been improving progressively and constantly.

887. What is the greatest number of vessels you have ever known to be in the harbour at one time, exclusive of fishing vessels?—434 sail in the two harbours; 181 in the basin, and 253 in the outer harbour, making 434 sail altogether.

888. What is the whole space within the walls for accommodating the number of ships you have mentioned?—The outer area is 42 acres in extent, and the inner area 12 acres.

889. Can you give an account of the number of ships that came into the harbour within the last 20 years?—I can.

890. Can you say the number within the last three years?—1600 sail of merchant-vessels on the average, exclusive of fishing-craft, the town hoys, and the regular packets in the season.

891. Are you enabled to state how many came for mercantile intercourse with Ramsgate, leaving it to be inferred that all the others came in to wait favourable winds, or for



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repair?—I am not able to give an account from memory, but I sent in statistics showing these particulars.

892. If British vessels, particularly coasters, were better found in sails, rigging, and ground tackling, and more attention paid to their caulking, would it not diminish greatly the necessity for seeking harbours of refuge?—I have no doubt of it. They are also sometimes so overloaded as not to be able to ride.

893. What are the rates of the harbour dues?—*2d.* per ton on vessels under 300 tons, and  $\frac{1}{2}d.$  per ton over and above that tonnage.

894. Where are the dues received?—At the Custom House.

895. Who receives the dues at this port?—The collector and one of the officers of the trust.

896. Do you know their average annual amount?—I do not; we have no account here of the amount of the revenues of the harbour. To speak from guess, I should say they were from 15,000*l.* to 20,000*l.* annually.

897. Do you know the average annual expenses?—No, I do not; but they have been very great of late years.

898. Have you sufficient back-water for your harbour?—It is considered by Sir John Rennie that it would be of great advantage to have it increased.

899. Increased by what means?—By an auxiliary dock or basin.

900. In what direction?—He (Sir John Rennie) proposes it to be to the westward of the harbour.

901. Would that scour these basins?—I think he would give the best opinion on that subject.

902. Do you know the extent of the proposed additional harbour?—I do not.

903. Do you know the expense, or the estimate?—I do not.

904. If a narrow basin were made, could it be cleansed by an auxiliary one?—I think not, because the chalk is of unequal strata.

905. Could you not excavate?—We could not excavate the narrow basin.

906. What would be the result of a new basin?—It would be of great benefit to the outer harbour.

907. Would not the outer basin be of great advantage?—It would give more accommodation for ships, and give a greater back-water.

908. Does the ebbing tide, or the back-water, or the sluices tend to increase the shallowness of the water by the collection of sand or mud outside?—Not in the slightest degree.

909. What is the depth of water in the fair-way of the channel at low-water spring-tides?—Outside the area, from eight feet at the transporting buoy, gradually deepening up into the Small Downs; and I believe it is there from six or seven fathoms.

910. Do you ever attempt to deepen the water by dredging, and what is the nature of the bottom; No. The bottom is of hard chalk rock.

911. Supposing the buckets of a dredging-vessel to be made small, and the lips powerfully armed, would not that reduce the chalk rock?—There is no question but that it would do so; it would take up the chalk by increasing the power of the engine.

912. Have you ever kept any account of the expenses of working the dredging-vessel?—I have inserted the account in those statistics which I sent to you. About *7d.* a ton is all the expense of getting them into the lighters, discharging them from the same, and getting them back for their work alongside.

913. The deepening of the fair-way to the channel would not be of much advantage unless you deepen the entrance of the harbour?—I don't think it would.

914. Could you deepen the entrance of the harbour without disturbing the lower part of the wall?—You could not deepen it, as the wall stands on caissons at the surface of the chalk rock.

915. In what depth of water are the caissons?—At low-water spring-tides, at the western pier head, they are in from four to six feet; and at the east pier head, at from six to eight feet. They were placed there eighty years since.

916. Are they of wood or iron?—They are of Riga timber.

917. What are they covered with?—They have no covering whatever, as the work was carried on from the brickwork down to the floor-edge; but where they have been uncovered, they were perfectly sound; as much so as on the day they were placed there.

918. When blowing a gale of wind from the south, and a heavy sea setting into the Downs, is it generally during the time that the tide makes to the northward ships part their cables?—Certainly.

919. Then vessels so breaking adrift are sure to have the flowing tide for entering Ramsgate Harbour?—Yes.

920. Are you aware of a proposal to increase the Small Downs by extensive works along the Brake Sand?—I have heard of it.

921. The plan (*which was here shown to Mr. Martin*) shows the proposed entrance to be open to the southward, would it not be constantly exposed to the heavy sea which tumbles in from that quarter in blowing weather?—Yes, it would.

922. Do you think ships would there obtain shelter?—I have not had an opportunity of inspecting the plan. To the best of my recollection, vessels under the Break would be sheltered from all winds.

923. What is the direction of the Brake Sand?—N.N.E. and S.S.W.

924. The proposed work along the Brake, being three miles and a-half in length, makes a passage between it and the shore, will this narrowing of space tend to produce greater velocity in the tides?—I should say it would.



925. If such an increase in the rise of the tides were to occur, and vessels were to ride there in southerly gales, would it not cause ships to ride harder in that anchorage than outside of it, where there is not so much tide?—I don't think it would, because the great increase of tide would be at the northern end, and not at the southern end. I do not think it would increase much at the southern end, where ships would ride.

926. I have been told that an increase of tide through the Brake would tend to diminish the shoals?—It would do so.

927. If it would be strong enough to do that, would it not be so strong as to be felt by the ships riding there?—In my opinion it would not be strong enough to injure ships riding there.

928. What do you suppose will become of the sand or mud that is to be carried away from the anchorage under the Brake; where will it be deposited?—It would go through the Cudd Channel into deep water, the easterly tide gradually assisting it, as it runs more than three hours after high water.

929. Would there be no reason to apprehend it setting in front of Ramsgate Harbour? I don't think there would.

930. It appears there is from 11 to 12 feet of water at the northern entrance at the Brake?—The average is 11 feet at low-water spring-tides.

931. Then, supposing a ship at anchor within the Brake anchorage to break adrift in a south-westerly gale, as she cannot pass through the northern channel, what is to become of her?—I consider that, in nine cases out of ten, vessels break adrift when there is water enough to enable them to pass through. We have many instances of ships breaking adrift in the Downs after high water, and passing through the Northern Channel, because the pilots doubt whether there is sufficient water in Ramsgate Harbour; and rather than risk going in there, they go round the land.

932. Supposing a ship to break adrift in the Downs, with the tide running to the northward, and flowing at Ramsgate, her course is sure?—She would go through the Gull Stream.

933. Supposing you are desired to select a place for a man-of-war rendezvous for giving protection to the trade of the Channel, and for menacing the coast of the enemy, would you propose the anchorage under the Brake?—I am not competent to answer that question.

934. Would you select that place?—It would depend entirely upon where the enemy's forces were.

935. Would men-of-war under the Brake be in a proper place to give protection to the trade of the Channel?—Not under all circumstances; it depends on circumstances.

936. Do you know anything of Dover?—Yes, I am a native of that place.

937. What do you know of it?—Dover Bay has very deep water, and it has also a moving shingle, which is a continual obstruction to its harbour; and I have always understood that if any means were taken to throw the shingle out into deep water, it would take away the beach from the Bay, and destroy the property situated there.

938. But if its harbour were increased, if it were surrounded by an artificial harbour, where the shingle could not get in, should you have any apprehension concerning the shingle or the beach then?—Certainly not.

939. Do you think Dover Bay a desirable position for a harbour of refuge?—It is the narrowest part of the Channel, and certainly a desirable position for such a harbour.

940. You see this map; here are three entrances, A, B, and C; do you consider that A, the western, would be likely to receive the shingle as it goes along, or that it would be better to stop up A and leave the opening more to the southward?—I consider it would be better to have the opening to the southward.

941. For ships coming up Channel and running to this proposed harbour, where would be the best place for an entrance?—The centre of the Bay.

942. Would you recommend an opening to the eastward?—I should recommend an opening to the eastward to any harbour, that the tide might go through it.

943. When you are under the Brake Sand what water is there to the northward at dead low-water spring-tides?—Nine feet at the lowest, and 11 is the average.

944. Then that never could admit vessels to pass through, drawing 18 feet water at all times of tide?—Certainly not.

945. (*Adm. Dundas.*) In the event of war, it would be necessary to have a capacious harbour, where vessels could be sheltered from all winds and weathers, and where vessels of war or war steamers might constantly be ready to slip out at a moment's notice, for the protection of the trade and the defence of the coast. For the construction of a harbour, combining with the above objects that of being a harbour of refuge for merchant-vessels, on what spot would you fix?—I should prefer Dungeness. The French have harbours more to the eastward, but I should consider Dungeness the best site; and if it were possible to have another such harbour also, I would have it at the Downs, for then the whole Channel would be completely at the command of these two places.

946. What sort of holding-ground is there in Dover Bay?—Very bad; it is chalk bottom in seven fathoms, and silt close in.

947. Is that at Dungeness good?—It certainly is better.

948. What water have you at the mouth of Ramsgate Harbour at dead low-water spring-tides?—Six feet between the piers.

949. Supposing you have additional water to sluice off, would that make any real difference at mouth of the harbour?—Not without the assistance of the dredging-machines.

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950. What is your reason for preferring Dungeness for the construction of a harbour of refuge to Dover?—Because it has a greater command of the Channel, is farther to the westward, is nearer to the Channel Islands and the entrances of the French rivers.

951. Supposing a fleet of merchant-ships to be at anchor in the Downs, which would be the most favourable position for their protection, Dover or Dungeness?—I should prefer Dover, as being nearer to the Downs.

952. Then for aggression you would choose Dungeness, and for protection to commerce you would choose Dover?—Dover would be better than Dungeness for the protection of the commerce in the Downs; but Martello towers on the Brake Sand would be better still.

953. How are vessels coming down the river with a south-west wind to get into such a harbour as Dungeness?—They would not attempt to work through the narrows as long as they could have a safe anchorage in the Downs.

954. (*Chairman.*) Supposing that a fleet of merchant-vessels are obliged to take shelter, is it your opinion they would take shelter within the Brake Sand, or attempt to go to Dungeness Harbour?—Certainly they would take shelter at the Brake Sand, because their greatest risk would be between the Downs and Dungeness.

955. Then you would prefer Dover as a harbour for a fleet of men-of-war to lie there to give protection to the trade; but you would prefer the proposed harbour within the Brake as a better harbour for trading-vessels to lie in?—The best means of protection would be for the cruisers to be with the trading-vessels.

956. Do you not think the cruisers would be better to be outside the merchant-ships?—No, I do not.

957. You have heard of the proposed harbour at Foreness?—I have.

958. Do you not think vessels would be more accommodated there than at the proposed harbour within the Brake?—No, I do not.

959. Do you know anything of the ground about Beachy Head?—I know it perfectly well.

960. If you were to have a breakwater at Beachy Head, which side would you prefer it to be constructed on?—There would be great difficulty on either side, on account of the heavy sea; but I would prefer the westward side, about Newhaven.

961. Is not the prevailing wind, at least for nine months of the year, to the westward?—From south-west to north-west are the prevalent winds.

962. Then, with the prevailing wind to the westward, would it not be better to have the harbour to the east of the Head?—It depends on the formation of that harbour or breakwater. If the breakwater was to be placed to the westward, then it would be of advantage to have the harbour to the westward.

963. Do you know enough of Newhaven to say why it is preferable for a harbour?—I am not sufficiently acquainted with it to do so. I have heard it spoken well of.

964. Does not a heavy sea tumble in to the westward, while to the eastward there is only a ground-swell, and it is sheltered?—We never trusted ourselves there when I served in the hired armed service at the Beachy Head station; we were rather afraid of it.

965. Whether would you prefer running to the bight on a lee shore, or to go under the shelter of the land to a port on the other side?—Certainly not on a lee shore; I should expect to find a harbour free of access.

966. In the case of vessels breaking adrift from the Small Downs, in strong westerly winds, with the stream running last quarter flood, would they find falling water in Ramsgate Harbour, or in the channel leading out to the north of the Brake?—Yes, they would.

967. (*Admiral Dundas.*) Could a ship-of-war go to sea in all weathers, with all winds, and at all times of tide, from a harbour of refuge constructed at the Little Downs?—It depends on their draught of water; if they could navigate the Channel they might.

968. As a person having experience in this neighbourhood, to which would you give the preference for the construction of a harbour of refuge, accessible at all times of tide, within the Brake or Dover Roads?—I should prefer a harbour inside the Brake, because we have no shingle there.

969. Looking at the present anchorage in the Small Downs, and to the protection that could be given from the shore, do you consider that a harbour of refuge for men-of-war to remain in for the protection of the trade in general would not be preferable in Dover Roads to the Small Downs?—I should prefer a harbour for such purposes being constructed in the Downs.

970. Explain how a squadron at the Brake could give protection to the Channel?—For protection to the trade of the Channel, Dover would be better than the Small Downs.

971. Would a squadron of steam-vessels within such a harbour as the proposed one at Dungeness protect the merchant-vessels in the Downs better than a squadron of steam-vessels within a similar harbour at Dover could do?—The subject does not admit of a question; but again I should prefer the Brake Sand to either for the protection of the Narrows.

972. Would not the position at Dover place a squadron in a better situation to intercept between the French coast and the Downs than that of the Brake?—Then I should say it would, but I was confining my evidence to the Small Downs.

973. Which would you prefer for a harbour for men-of-war to enter and remain in



for the protection of that part of the Channel, Dover, or Dungeness?—I should prefer Dungeness; because I consider it has the greatest command of the Narrow seas.

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974. (*Chairman.*) What is the distance from the South Sand Head to Dungeness?—I should think it is about 23 miles.

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975. Do you think a squadron stationed at Dungeness would be in a situation to give effectual protection to a fleet of merchant-men in the Downs?—I do not.

976. What is the distance from South Sand Head to Dover?—About five miles, and from Dover to Dungeness about 18 miles more.

977. Then the protecting squadron would have five miles to run to afford protection if stationed at Dover, and 18 miles additional if stationed at Dungeness?—Certainly, if the fleet to be protected were in the Downs.

978. In that case, which locality would you select for a harbour of refuge?—I would prefer the nearest, allowing for the alteration in transit caused of late by means of steam, the difference in the respective distances from the Downs would be more matter of consideration; but our cruisers during the last war always preferred Dungeness as a point to watch from, that they might give protection to the trade of the Channel with the greatest effect.

979. Meaning, that at that time Boulogne was the principal port to which all eyes were directed?—Dieppe possessed the swiftest and most powerful privateers, which effected the most mischief, and therefore the cruisers about Dungeness afforded more protection to the trade than those at any other point, and had orders to hold thereabout as long as they could, and not to quit that station.

980. I wish to ask you whether you consider that the Royal Sovereign Shoal, and other shoals about it, would not be an impediment to your making a breakwater to the eastward of Beachy Head?—They certainly would.

981. With regard to Dungeness, do you remember in what part of the Narrows the greatest number of English merchant-ships were captured by the French from Dieppe, and other French ports during the war?—Between Dungeness and Beachy Head.

982. (*Capt. Washington.*) You said that during the war Dungeness was the best station for cruisers to protect the Channel?—It was considered so.

983. Was that not chiefly owing to its being to windward in the prevalent winds?—It was.

984. And since the establishment of steamers, that advantage has been lost?—Not altogether; steam-boats like fair winds. A steam-vessel would tow away a prize better when she could get her canvass to help her engines.

985. You stated that Boulogne and Dieppe were the chief points which sent out the most mischievous privateers; have not Calais and Dunkirk become very important points for steamers since that time?—I have heard that Calais, but not Dunkirk, has been improved.

986. But if Calais and Dunkirk were improved would they not then become points of great offence for steamers, against our merchant navy?—The privateers from Dunkirk confined themselves during the last war principally to the North Sea.

987. Would not Dover, as a naval point, be better able to protect ships in the North Sea and the Channel than a place 20 miles further to the westward?—In the North Sea, but not in the Channel.

988. (*Capt. Fisher.*) You say that you were employed during the war to protect the Channel while you served in a cruiser; was there not then generally a large fleet of men-of-war in the Downs?—Generally; but all the fast cruisers were at Dungeness. All those cruisers which had to look after the privateers were stationed at Dungeness.

989. Do you consider that ships in the Downs were a natural defence to the mouth of the River?—Certainly.

990. To what winds in the Small Downs are ships most exposed?—From S.S.W. to S.S.E.

991. What is the protection against other winds?—The South Foreland from the south-west westerly, and the Goodwin Sands from the south-east easterly.

992. Do you consider that these natural protections are sufficient against all other winds in all weather?—Yes; except they are very heavy, or hurricanes.

993. As you say the anchorage within the Brake is open to the S.S.W., does not the wind from that quarter bring in a heavy sea?—I think the wind from the south brings in a heavy sea.

994. (*Sir H. Pelly.*) The Goodwin Sands and the proposed work lying along the Brake in a S.S.W. direction would be nearly in a parallel direction?—I have not examined the plan sufficiently to answer that question. It would appear so from this plan.

995. The Goodwin Sands are a great protection from outward winds?—Yes, they are from S.E. easterly.

996. You stated that the anchorage in the Little Downs was open from S.S.W. to S.S.E., and that it embraces four points of the compass; to be more secure in your answer to the second question, you said that the Foreland protected from S.W., and the Goodwin from the S.E., making 8 points of the compass. Now, supposing a breakwater to be laid down in that direction, so as to cover 8 points in the Brake, would that not be a complete protection to vessels within the Brake?—Certainly.

997. (*Chairman.*) Could vessels get out of the North Channel at all times of the tide?—They could not.

998. What is the rise of tide required for vessels drawing 18 feet water in order to pass out of the North Channel?—Such a vessel might go out at half flood.



Mr. Kennet B.  
Martin.

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999. You are well acquainted with the power of steam?—I am perfectly well acquainted with it.

1000. Have you ever found south westerly gales to be so heavy between here and Dungeness that a powerful steamer could not face it?—It must be a very large class steamer that would face a south westerly gale in the Narrows.

1001. Suppose there were a refuge harbour in Dover Bay, could not a powerful steam-vessel then get up to Dungeness from that harbour in any weather?—It must be a powerful one to be able to do so.

1002. You said that if a breakwater were to be run out from the south end of the Brake towards the shore that it would give protection?—I should have no apprehension of shingle passing through the opening into the anchorage; I should think there would not be any shingle there.

1003. I wish to ask you whether in hard gales of wind from N.N.W. to N.N.E. there is not a heavy swell, as heavy as from the S.S.W.?—Not in the Small Downs, but there is in the Great Downs.

[The Witness withdrew.]

Thomas Aylesbury, called in and examined.

1004. (*Chairman.*) In what capacity are you serving?—I am warden of the Cinque Ports pilots at Ramsgate.

1005. How long have you held that office?—I think about 10 or 12 years, and I have been a pilot 24 years.

1006. Are you well acquainted with the anchorage about Foreness?—Pretty well.

1007. Have you seen the plan for a proposed harbour at Foreness?—I have not.

1008. (*Plan here shown Witness.*)—Does the trade coming from the North Sea make the North Foreland?—No; they frequently make the lights of the Goodwin.

1009. Supposing a fleet of ships to be at anchor in the proposed harbour outward bound, and the wind coming from the eastward, how can they get out of it?—Then they might with difficulty by getting round Long Nose Buoy.

1010. How far is the entrance of the harbour from the edge of Margate Sand?—About 5 miles.

1011. How would vessels get out into the fair-way of the Channel with a heavy sea and the wind at N.N.E. or N.E.?—They would get out with great difficulty, the wind blowing hard.

1012. In point of fact, could a fleet of convoy ships depart from the proposed harbour with the wind at N.N.E.?—In a gale of wind they could not, but in fine weather they could.

1013. Should you from your experience think Long Nose a desirable position for a harbour of refuge for the trade of the country?—I should not.

1014. Why not?—It is a bad position and on the wrong side of the Foreland.

1015. Have you seen the plan of a harbour within the Brake Sand?—I have never seen one.

1016. (*Witness was here shown the plan.*)—You see the plan is to construct a work along the whole length of the Brake Sand. Suppose that a ship at anchor within the Brake parts her cable in a gale of wind, inside the buoy of the Brake where the proposed harbour would be at night time, what is to become of her; I mean a ship drawing 18 feet water, can she get to the northward?—No, she cannot; but she could at the top of high water, or even an hour before or after.

1017. What is the least depth of water in the fair open anchorage near the fair-way buoy?—To the southward of the buoy 4, 5, and 7 fathoms.

1018. Would the present depth of water at the fair-way of the North Channel permit a vessel passing out drawing 18 feet water?—No.

1019. Have you been accustomed to the south-eastern coast?—About Beachy Head, I have.

1020. What is the depth of water in the Cudd Channel?—Nine feet in low-water spring-tides.

1021. What is the rise of water?—In ordinary tides it is 10 or 12 feet; and 16 or 17 is the depth with spring-tides, making about 25 feet at high water.

1022. You stated that at low-water spring-tides there was only 9 feet water in the Cudd Channel, could you not take a ship out at an earlier period than half flood?—It might be possible, but I would not attempt it.

1023. You know the coast of Kent well?—Yes, about Dover and Dungeness; but I have not been in the neighbourhood of Dungeness much lately.

1024. (*Adm. Dundas.*) In the event of war, as it would be necessary to have a harbour for steamers to be constantly ready to slip out at a moment's notice night and day for the protection of the trade and the defence of the coast, and to combine that object with that of being a harbour of refuge for merchant-vessels, at what place would you recommend that such harbour of refuge should be constructed?—As near the south Foreland as possible, or Dover.

1025. If you made a harbour at Dover, where would you form your entrance into that harbour?—I should place an entrance towards the south-west end, in order that ships might lie out on the larboard tack with the wind S.E.



Mr. Thomas  
Aylesbury.

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1026. Supposing you were to continue Cheeseman's Head out seaward into six fathoms water, would you prefer that it should be a close pier or an open one that the shingle might pass through?—I should prefer that it be closed up.

1027. Supposing another entrance were to be made, where would you place such entrance?—I should not propose a second entrance myself.

1028. Are you acquainted with Beachy Head?—I know it very well, as I have navigated there, and served my time in the coasting trade.

1029. If a harbour were to be constructed in that neighbourhood, about what place would you erect it?—To the westward, about Newhaven, because I should think ships would be able to get out from there with a fair wind going down Channel.

1030. You would prefer making an artificial harbour about Newhaven?—Yes.

1031. As a seafaring man, in a south-westerly gale and you off Beachy Head, which would you rather find, a harbour constructed surrounding Newhaven, or one on the other side of Beachy Head to the eastward?—One to the eastward would be better to run for, because Newhaven lies in a bay on a lee shore.

1032. Supposing Newhaven to be surrounded with a deep-water harbour, should you then have any fear of running on a lee shore?—There would be fear of running on a lee shore, but I would guard against it by heaving my ship to in time.

1033. (*Capt. Fisher.*) Do many ships anchor at Beachy Head?—Merely to stop tide.

1034. Supposing that you were called up to fix on a position which you would think best, in the narrow part of the Channel, beginning, for instance, from the North Foreland down to the Isle of Wight, for the construction of a harbour in which a squadron of men-of-war steamers might give protection to the trade of the Channel, where would you place it?—At Dover.

1035. And supposing the two places were required for the steamers to lie in to render protection to the Channel, and, at the same, to be convenient for the trade, where would you then place them?—In my opinion there ought to be one at Dover, and the other at Dungeness, about the East Bay.

1036. To what points of the compass is the anchorage in the Downs most exposed?—From S.S.W. to S. by E.

1037. How long does the stream tide run to the eastward after high water by the shore?—About three hours.

1038. Then supposing a ship to break adrift from the Little Downs, after half flood by the stream, would she find falling water about Ramsgate, and in the passage out to the Northward?—Yes, she would.

1039. Do you consider a safe passage out could be made for ships breaking adrift in the Little Downs at all times of the tide?—It could be made better than it is; but I am not quite competent to answer that question.

1040. Are you acquainted with the opposite coast?—I know something of it.

1041. Do you know if the shingle travels there?—No, it does not, between Cape Grisnaz and the Texel.

1042. Is there no shingle at all there?—None; there is sand on that coast.

1043. (*Sir W. Symonds.*) What description of holding-ground do you have at Dungeness?—Good holding-ground.

1044. What is its quality at Dover?—Not quite so good, as it is rather hard.

1045. If there were large pier harbours constructed both at Dover and Dungeness, and you were in a small bad sailing merchant-vessel, which of the two harbours would you anchor in, Dungeness or Dover?—In that case I should go to Dungeness for shelter.

1046. Then you think the proposed harbour at Dungeness would be safest for small vessels?—Yes, I do; because there they would have to encounter less tide than at Dover.

1047. At night, I particularly wish to ask you, which would you soonest go to, a harbour under low land, as Dungeness, or a harbour under high land, as at Dover?—At night I should go under the high land at Dover.

1048. What is the difference in the wind under the high lands and low lands?—The wind is more true under low land than it is under high land.

1049. Should you experience baffling winds under high or low lands?—High lands.

1050. (*Admiral Dundas.*) Do you know anything about steam-vessels?—Yes, I have commanded one.

1051. In a gale of wind could a powerful steam-vessel go from Dover to Dungeness, with the wind at S.W.?—In an ordinary gale she could.

1052. Is there any silting in Ramsgate Harbour?—A little.

1053. What do you think it arises from?—It is my opinion it comes from Sandwich Haven.

1054. You have named Dover as a place suitable for the harbour of refuge, do you apprehend that it being inclosed would cause it to become filled up?—I think it would in a measure, and that it would require artificial means to keep it clear.

1055. Supposing a pier or break-water to be made on the Brake Sand, and inclosed also, do you think it would be liable to become filled up?—It would, in certain parts of it.

1056. You said you recommended only one entrance to a harbour at Dover?—Yes.

1057. Supposing it had another entrance to the eastward, would that reduce the tendency of the harbour to silt up?—It would do so, but it would give a greater range of sea in the harbour.

1058. If two entrances were made, how would it cause a greater sea inside the harbour?—By the current passing from the one to the other, taking the sea with it across the dead wall.



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1059. Knowing the prevalence of westerly and S.W. winds at Dover, and looking at the plans now before you, do you think there would be any difficulty in a ship entering the proposed harbour at all times of tide and all winds?—With two entrances there would be no difficulty.

1060. Referring again to the last question, what do you think would be ample width for the western entrance to enable the largest ships to come in at all winds excepting the S.E.?—Six hundred or seven hundred feet.

1061. Alluding to the proposed work along the Brake, supposing, contrary to your expectation, it should increase the run of the tide so as to sweep away the shoals, what would become of the sand and shoal stuff?—It would be carried away by the tide to the northward, or to the Quern shoals.

1062. Do you think it would come to the mouth of the harbour of Ramsgate?—I think it would come near the Cudd.

1063. Have you any reason to suppose that the Brake Sand has altered its situation?—Not materially; but I think it has altered a little to the southward; the south Brake-head extends farther to the southward than it did 30 years ago.

1064. Do you not consider it has shifted bodily to the westward a considerable distance?—I think not in shore.

1065. Have the buoys not been moved?—I believe the south buoy has been moved.

1066. Are there any marks inside to keep you clear of the Brake Sand?—Yes; the same as there were twenty-four years ago.

1067. What depth of water would you find at the Fair-way buoy at low-water spring-tides?—From 11 to 12 feet.

1068. What is the distance to that buoy from the entrance of Ramsgate Harbour?—About 3 miles.

1069. During those 3 miles have you no deeper water than is to be found at the Fair-way buoy?—Yes there is.

1070. What is the general feature of the soundings?—Varying from 2 to  $2\frac{1}{2}$  fathoms.

1071. Have you any deeper water towards the Brake?—Yes; to the southward.

1072. Abreast of the Fair-way buoy, is the water deeper or shoaler in towards the Brake?—I should say it is shoaler.

1073. Have you ever been along the edge of the Brake?—Yes.

1074. Is there less water along the edge of the Brake than  $2\frac{1}{4}$  fathoms?—Yes; there is less water than that.

[The Witness withdrew.]

Mr. Werter Clark.

Mr. Werter Clark, called in and examined.

1075. (*Chairman.*) In what situation are you?—I am a Cinque Ports pilot.

1076. How far does your branch extend?—To Gravesend in the river Thames, to Standgate Creek in the Medway, to the Owers in the Channel, to the Texel along the coast of Holland and Flanders, and Boulogne on the coast of France.

1077. If you were required to fix on a place the most suitable to serve as a rendezvous for a squadron of war-steamers for the protection of the Channel trade in the time of war, and at the same time to serve for a harbour of refuge for the convenience of the state, what situation between the North Foreland and the Owers Light would you select?—Dover Bay.

1078. Have you ever heard of a project for including the Small Downs, by a work along the Brake?—I have heard of it.

1079. Do you think such a work extending along the whole length of the Brake would make a desirable harbour for war purposes and the convenience of the trade?—I do not; I do not think there would be sufficient water for large vessels excepting at the entrance, and again those vessels lying at the southern part would be much exposed to northerly winds generally.

1080. What is the effect of N.N.W. and northerly winds?—They have a great length of distance in the fetch, being so distant from the land as at times to cause a nasty sea; and vessels drive from their anchors in gales with the wind at N.N.W.

1081. You say these winds occasion much sea?—They cause a very nasty sea, and hard riding, as the ground in that part of the Downs is not very good, and is in many parts chalky.

1082. In the Northern Channel, between Ramsgate and the Brake, what water have you?—Nine feet at low-water spring-tides.

1083. At what time can vessels drawing 18 feet water pass into Ramsgate?—It depends on the tide; they could not at all in neap-tides.

1084. Could not the same tide that gives water over the Channel shoals give water to the harbour?—No; there is more water over the shoals than at the harbour.

1085. How many years have you been in the habit of piloting the Channel?—Almost the whole time I have been at sea; and I have been at sea 38 years.

1086. Have you been much in the neighbourhood of Beachy Head during that time?—Not much; I have been more about the Downs and the North Sea.

1087. You have mentioned Dover as a place you would prefer for an artificial harbour, which place would you consider the best for another such harbour as the proposed one at Dover, for war purposes, and for large commercial vessels?—I know of no other eligible point.



Mr. Werter Clark.

14th May, 1844.

1088. Are you a native of Dover?—I am.
1089. Which has the best holding-ground, Dungeness or Dover?—Dungeness has.
1090. (*Admiral Dundas.*) You know a good deal about steam, in a gale of wind from the S.W., taking advantage of the tide, could a steam-vessel get from Dover to Dungeness?—Generally speaking, she could. There are sometimes gales when she would not be able to face them; but I think she would be able to proceed thither in moderate gales.
1091. Do you know anything of the intended harbour at Foreness?—Nothing farther than what I have seen to day.
1092. Were you ever at Beachy Head in a gale?—Yes, I have.
1093. How was the wind?—I have been there in S.W. and southerly gales.
1094. What are the prevailing winds in this part of the Channel, are they S.W. and S.?—Yes, they are.
1095. On which side of the Head would you make a harbour?—On the eastern side.
1096. Have you ever been at anchor in Eastbourne Bay?—Yes.
1097. Do you think the Royal Sovereign Shoal in the way of making a harbour there?—No, I do not.
1098. How far is the Royal Sovereign Shoal from the land?—I think about 5 miles.
1099. Were you ever at anchor at Newhaven Harbour, inside?—I have never been inside the harbour; but I have been at anchor in Seaford Roads.
1100. Do you know the nature of the ground?—I have not been there sufficiently often to know its nature.
1101. Knowing the prevailing winds to be westerly, which would you say would be the most advisable situation for a harbour for the protection of the Channel, the eastern or the western side of the Head?—I should prefer the eastern side.
1102. Speaking of the Brake, do you think there has been any diminution in the depth of water within the Brake?—I think not; the Brake towards the Middle Buoy, or Chequered Buoy, seems to have gone in towards the land since I can recollect.
1103. You said you were a good deal employed in the North Sea, would the proposed harbour at Foreness be of advantage to vessels going up the River or down Channel?—I do not think it would.
1104. You stated that you would prefer a harbour in Dover Roads, can you give us your reasons for this choice?—I should prefer a harbour of refuge at Dover, because of its proximity to the opposite coast in one respect, and also on account of its fortified situation.
1105. You would prefer it from its nearness to the opposite coast?—Yes; and another reason is, that vessels from the Downs with neap or common tides could attain that harbour when they could not get to one if it was farther to the westward. It must be an indifferent vessel that would not reach such a harbour at Dover in a common tide.
1106. Do you mean to say that if it was blowing strong, vessels could get into that harbour?—I do.
1107. You mean in such weather as a ship could make way with?—Yes; and I should consider it more easy of access to vessels proceeding to the westward than one farther west.
1108. (*Capt. Fisher.*) You say that the Brake has shifted within your knowledge: are you aware whether there is any difference in the leading marks?—There are no marks for leading along the Brake: but only to lead the way through the Gull Stream.
1109. Then I wish to ask you what are your marks in running down inside the Brake in a dark night?—I generally find my position before dark, and am guided by the compass in getting my position till I advance towards the harbour.
1110. Is it not the case that in running down inside the Brake, keeping the North Foreland Light just open, and occasionally shut in, has been the guide for the last 30 years?—I should say, that if I were to attempt to shut the North Foreland Light in when a vessel first enters between the South Brake Buoy and Sandown Castle, I must run her a-shore, on the main.
1111. I wish to ask you, with respect to the north passage into the Brake, at what time of tide a ship drawing 17 feet of water can pass over?—It ought to be within two hours of high-water, speaking of spring-tides.
1112. Supposing a harbour of refuge to be constructed at Dover, can you give us any idea of what you consider a proper width for a southern entrance, as shown upon the plan now before you?—I should say about 800 feet.
1113. Do you think that the entrance as shown upon the plan is in a proper situation?—I think it would be better in the centre.
1114. Would you prefer a second entrance also?—I should like an eastern entrance also; because vessels with easterly winds might take shelter in the proposed harbour, as they do now anchor in Dover Roads frequently; and then with southerly or westerly winds, they would have a fair outlet to the eastward.
1115. Do you think the shingle would pass into deep water if a pier was run out?—I think it would.
1116. And that, by having the principal entrance more in the middle of the harbour, there would be no fear of the shingle entering the harbour?—With the entrance about the centre of the harbour, I think the shingle would not enter in, which might be the case with it farther to the westward.



## DOVER.

*Thursday, 16th May, 1844.*

Admiral Sir T. BYAM MARTIN, in the Chair.

Mr. *Stephen Norris.**Stephen Norris*, called in and examined.

16th May, 1844.

1117. (*Chairman.*) Are you a branch pilot at Deal?—I am.

1118. Extending how far?—To the west end of the Owers and the Texel.

1119. How long have you held your branch?—Forty-one years next September.

1120. And you do still?—Yes; I am one of the wardens.

1121. Are you well acquainted with the anchorage within the Brake Sand in the Downs?—Yes; very well.

1122. Do you think there has been any change or movement in the Sand of late?—I have not found any outside the Sand; but inside the Sand, it is doubtful whether it has or not.

1123. Do you consider the anchorage within the Brake a good and proper anchorage for vessels of all draughts of water?—It is not safe for vessels of large draught in its present state.

1124. What do you mean by saying “not in its present state”?—That, in the case of a ship going adrift there is no outlet for her to the northward.

1125. Speaking generally of the anchorage within the Brake, what is the least depth of water in spring-tides, in any part of the Small Downs?—From the Brake to the Castle you find it is from seven, five, and four fathoms, regular to the shore; and a mile further there is rather less water, for there it is from six to five, and from four to three fathoms to the shore at low-water spring-tides.

1126. Which is the heaviest sea you have in the Small Downs?—It is most felt from S.S.W.; the wind at N.N.W. being off the land, ships can ride safe.

1127. Is there any considerable sea sent down with the wind at N.N.W.?—The Small Downs is the best place for riding a ship with the wind at N.N.W.

1128. Should you think it more desirable to have the Small Downs converted into a harbour by a work extending along the whole length of the Brake Sand; or, from your knowledge and experience, would you prefer one at Dover?—I shall give you my candid opinion, the Small Downs is a good and safe place; but in case of accident, by ship breaking adrift, there is no outlet for her to the northward, if she is not of a small draught of water.

1129. Is not the Little Downs as safe and as good an anchorage, as far as a S.S.W. gale is concerned, in its present state as it would be with a work along the Brake?—It is for a small ship, but not for a large one.

1130. If carried along the Brake only it would be no protection?—It would not with the wind at S.S.W.

1131. (*Admiral Dundas.*) Mr. Norris, in the event of war it would be necessary to have a harbour on the coast of Kent, where war steamers could be sheltered from all winds and all weathers, and to be constantly ready, night or day, to slip out at a moment's notice for the protection of the trade of the coast; and to combine with that object that of being a harbour of refuge for merchant-vessels, at what spot on the coast of Kent, from Beachy Head to the North Foreland, would you say such a harbour, to be accessible at all times of tide and in all weathers, ought to be constructed?—I should consider Dover the most eligible situation for such a harbour.

1132. In a gale of wind at S.W., could a powerful steam-vessel get down from Dover to Dungeness?—Yes; a powerful steamer might.

1133. Do you know anything of Beachy Head?—Not much.

1134. With a sea-wall along the Brake, and a breakwater at S.S.W., could the anchorage under the Brake be made a harbour of refuge, accessible at all times of tide, night or day?—No; it could not.

1135. (*Sir Henry Pelly.*) Would not a breakwater drawn from Sandown Castle towards the South Brake Buoy, and so protecting the vessels within that line from S.S.W. winds, and sheltering them by another breakwater from S.E. winds, form a good harbour of refuge?—It would be a capital harbour for outward-bound ships.

1136. Would it not be accessible at all times of tide, and in all winds, to steamers both in and out, at that one opening?—There certainly would be nothing to hinder it answering such purposes.

1137. And vessels drawing 18 feet water in its present state would be able to get out?—They would never get out to the northward, excepting at high-water spring-tides.

1138. What water is there in the Cudd Channel?—At low-water spring-tides no more than eight feet; and the rise of the tide is 18 feet at spring-tides.

1139. Therefore at the top of high water a vessel would have 26 feet water to go out by?—Certainly.

1140. I am speaking of a breakwater, independent of the line along the Brake. Supposing this line to be carried a little further to the westward, towards Deal, and carried in the same line across, would not that make an additional capacious harbour for vessels of all descriptions?—I should say that all ships might ride there.

1141. (*Captain Fisher.*) I believe you answered a question put to you, as to which situation you would prefer a harbour of refuge to be constructed at between the North Fore-



land and Beachy Head, capable of receiving outward and homeward bound ships of any burthen, and also men-of-war, at all times of tide, by selecting Dover?—Yes; I did.

1142. Supposing a ship to break from her anchors in any harbour constructed in the Little Downs at any time between half-flood and half-ebb by the stream, would she find falling water both at the entrance of Ramsgate Harbour and at the passage leading out to the northward of the Brake?—Certainly the water would be falling.

1143. Are you aware of any means that could be found for making these channels to the northward of the Brake available for vessels of the description already stated to you, and to render them navigable by night, supposing these passages to be deepened?—If the passages were deepened, you could certainly place lights.

1144. Are they of such a nature as to be made available by marks on the shore?—I think they might be deepened to be rendered navigable.

1145. (*Sir Henry Pelly.*) Is not the light on the pier head, with the light on the shore, now the mark for running out?—It is, and ships always run out by it.

1146. Then supposing a ship breaks adrift from the Downs, with these marks could she not go through the Cudd Channel?—Certainly, she could with these lights if the weather was clear, so as they might be visible.

1147. Would the same marks in the present state of the Cudd Channel carry a vessel through it from the Little Downs?—No.

1148. What depth of water would you now find in passing out from the Little Downs to the north of the Brake at any time within two hours of high water?—After I got down to the Fairway Buoy, I should find very little; there might be from 14 to 15 feet.

1149. (*Capt. Fisher.*) As a pilot of long experience on this coast, from which place do you consider a fleet of merchant-ships or single vessels detained by stress of weather could make their passage down Channel, from a harbour of refuge constructed in Dover Roads or one constructed on the east side of Dungeness?—They would from Dover Roads, because, with the wind southerly and easterly, they would not be able to get out of Dungeness.

1150. (*Sir William Symonds.*) Look at this chart. Would a ship making sail from a harbour, constructed on the east side of Dungeness, have to make a course three points more to the southward, in rounding the point, than she would from a harbour constructed at Dover?—Certainly she would.

1151. Look at the plan, and see the extent of the proposed breakwaters forming a harbour of refuge at Dover; and as an old experienced pilot, state what is the nature of the ground at four distinct points which I will mark, and say whether in all of those situations you would bring a large ship up, which would generally be necessary in an anchorage crowded with vessels taking shelter?—At the eastern section of the anchorage there is chalk; at the second, about the Castle Jetty, sand; at the third, to the westward, near Guildford Battery, mud; and at the fourth, mud still. I would not bring up short a large ship on the chalk.

1152. Do you consider that in light baffling winds it would be possible to get a large fleet of merchant-ships inwards, through the opening to the southward, when either flood or ebb-tides are passing across the entrance?—I should think not, with a large fleet.

1153. What is the rate of the tide-stream on the line where seven fathoms would be found at low-water spring-tides?—I should think three and a half knots.

1154. Should a strong gale spring up from N. to N.W., could heavy merchant-vessels work in at either entrance in the night or day, the harbour being crowded?—It would be doubtful whether she could. If the harbour was crowded, I should think it would be dangerous to work a ship in.

1155. Could a heavy sailing merchant-vessel get out at either entrance, if it were to blow a heavy gale from S.E.?—She could; I see nothing to hinder her.

1156. So as to prosecute her voyage down Channel?—Yes.

1157. What is the quality of the holding-ground to the eastward of Dungeness, where ships anchor?—It is mud, and is very excellent holding-ground.

1158. Supposing a breakwater, two miles long, were made to shelter ships, similar to the one shown you with the winds from S.W. to north and by east, in seven fathoms at low-water spring-tides, would that in your opinion make a good harbour of refuge for large fleets of merchant-men, attended by steamers and other ships of war?—Yes.

1159. (*Chairman.*) You have stated the difficulties of entering the projected harbour at Dover in blowing heavy weather, and the harbour in a crowded state; I ask you, would not the same difficulties exist in any other crowded harbour?—Yes.

1160. (*Admiral Dundas.*) Which of the four sections of the anchorage in the proposed harbour at Dover Bay has chalk bottom?—The one nearest the Foreland.

1161. In running into the harbour with a gale from W.S.W., would you have an entrance to the westward, that your ship might shoot in?—I would.

1162. Supposing she lets go her anchor, does she drive up hill?—Yes.

1163. With the assistance of steam-tugs, could any number of ships be taken in and out of the harbour?—Yes, they could.

1164. And with the wind at N.W., ships would find shelter as they do now in any part of the harbour?—They would.

1165. In winds from N.W. or N.E., or in light baffling winds, vessels might go in or out in any weather?—Yes.

1166. (*Sir Henry Pelly.*) Would not the same wind that would enable a ship to go down Channel, permit her to go out of the proposed harbour?—Yes, it would.



Mr. Stephen Norris.  
16th May, 1844.

1167. (*Captain Washington.*) Have you been in the habit of bringing ships into Dover Road?—Yes.

1168. Do ships often bring up in Dover Bay?—Not unless the wind is at N.E.

1169. Have you ever seen a ship drive from her anchor in Dover Bay, between Cheeseman's Head and the Cornhill Coast Guard Station?—Never.

1170. You said the rate of the tides was three and a half knots on the springs; have you ever measured it?—I have on many occasions done so, and found it to be even four knots, but not generally speaking.

1171. Do you not consider the present anchorage in Dungeness, East Bay, in south-westerly gales, very good?—It is excellent holding-ground, and a ship may ride there long enough if she has got good chains.

1172. Do you think there is sufficient room there for 200 ships?—Yes, there is.

1173. How long before high water in Dover Bay by the shore does the tide-stream turn to the N.E.?—When it is half-flood by the shore.

1174. (*Chairman.*) Are you residing at Deal?—I am a native of Deal, and it is my place of residence.

1175. Have you any interest in connexion with Dover?—Not a bit of it: I should speak of any place, did I think it most suitable to benefit the country.

1176. Looking at the plan for a harbour of refuge at Dover, and supposing the breakwater from Cheeseman's Head to be carried out into six fathoms water at low-water spring-tides, do you think the shingle in south-westerly gales would be likely to get into the harbour?—I should think not; but I should consider it better to carry the breakwater into seven fathoms water.

1177. Why should you prefer its being carried out into seven fathoms water; is it in reference to the shingle, or to give a greater scope of anchorage inside the harbour?—I wish to afford a greater scope of anchorage.

1178. (*Sir Howard Douglas.*) Looking at the plan now before you, showing three different places of entrance, where do you think would be the best position for a western entrance, for an easy and convenient ingress to shipping in a south-westerly gale?—In the centre, which is 600 yards eastward of the line of Cheeseman's Head.

1179. Supposing Dover Bay to be enclosed with a breakwater, how many entrances would you have to it?—I should prefer two entrances: in addition to the central entrance I should recommend an eastern entrance, about 700 yards from the shore.

1180. (*Chairman.*) Do you think a passage between high and low-water mark for the tide to pass through would be desirable?—I do.

1181. Supposing there was no passage between high and low-water mark, do you think the shingle would accumulate in the N.N.E. corner of the harbour?—I should think it would drive up in the corner.

1182. (*Captain Washington.*) Supposing a breakwater were to be formed, which of the spaces would you prefer?—I should select the outer seven fathom breakwater.

1183. Is your reason for carrying it into deep water that it might accommodate ships of the largest class?—Yes, it is.

1184. (*Captain Fisher.*) With your experience of 40 years on this station, where you have had much anchorage, would you have any hesitation, consistent with your duty for the safety of the vessel in your charge, in taking her into the proposed harbour at Dover during a gale of wind?—Certainly not.

1185. Why do you prefer the central entrance that you have selected to the proposed harbour, would it permit vessels to sail out in any wind that would take them down Channel?—Yes; they could sail out of it with the wind at S.W.

1186. (*Mr. Walker.*) Your attention has been particularly directed to the position of the entrance. Knowing Ramsgate Harbour entrance to be 200 feet width, what width do you consider the western entrance of the proposed harbour should be?—I should say it ought at least to be 600 feet wide.

1187. (*Lieutenant Col. Colquhoun.*) How wide would you have your eastern entrance?—I should think 400 feet would be wide enough.

1188. (*Mr. Walker.*) You said something about the tide clearing the eastern entrance; what did you mean when you said you would require an eastern entrance to keep the harbour clear?—I was speaking of the beach.

[*The Witness withdrew.*]

Mr. Thomas Bailey.

Thomas Bailey, called in and examined.

1189. (*Chairman.*) In what situation are you serving?—I am clerk to the fellowship of pilots of Deal, and the oldest one on the station.

1190. How long have you been on that station?—I have been 54 years a pilot.

1191. (*Captain Fisher.*) Where in your opinion would be the best place to establish a harbour of refuge for the trade generally, outward and homeward bound; this harbour to be accessible at all times of tide, for men-of-war, armed steamers, and merchant-vessels of the largest dimensions, between the North Foreland and Portsmouth?—From what I have seen and observed, I must prefer the Downs.

1192. (*Chairman.*) Do you mean the Great or the Small Downs?—I mean the Small Downs, though both might be included.

1193. (*Captain Fisher.*) Are you of opinion that ships of the description already stated,



seeking shelter in the place you propose from storms or for protection from the enemy, could proceed on their voyages outward or homeward bound, as the case might be, in all winds and all weathers?—The outlet to the northward of the Brake may be considered as having shallow water, and they could not pass through it at all times of tide.

Mr. Thomas Bailey.

16th May, 1844.

1194. Supposing a ship to break from her anchors in the situation you propose in the Small Downs, at any time of tide between half-flood and half-ebb by the stream, would she not find falling water both at Ramsgate Harbour and the passages leading out to the northward of the anchorage you propose?—She would find falling water.

1195. What depth of water would she find in passing out at the time stated in either of those places?—I think that she would find about 16 or 17 feet water.

1196. Would she find that water even from the situation of the buoy of the Fairway, which, I believe, is three miles from either of the other places above stated?—From two hours before till two hours after high water she would.

1197. Supposing a harbour of refuge were constructed anywhere between the North Foreland and Dungeness, from what situation do you consider vessels outward bound, detained by stress of weather, would make their passage down Channel?—In my opinion the best situation would be Dover.

1198. Should you feel any difficulty, or any objection, to taking a vessel into a harbour constructed at Dover, from your knowledge of its anchoring ground?—No.

1199. (*Sir Howard Douglas.*) Supposing Dover Bay to be enclosed by a breakwater, how many entrances would you make, and where would you place them?—I should have two entrances; one as far to the westward as I could have it for the convenience and safety of the ships; and I should also have one to the eastward.

1200. (*Chairman.*) In speaking of an eastward entrance, you mean it to be in a position where you would have the least cross tide?—Yes, I do; as it would be most safe for the navigation of ships.

1201. (*Sir W. Symonds.*) Where would you drop your anchor in coming in with a south westerly gale?—It depends on the situation of the shipping previously arrived.

1202. Where is the best anchorage?—The best anchorage is opposite St. James' Church in the valley, where the bottom is inclinable to a sort of clay mixed with chalk.

1203. What is the ground further to the eastward?—I cannot speak to that.

1204. (*Sir Howard Douglas.*) Would you under any circumstances of wind or time hesitate in taking a vessel into the projected harbour through the entrances you have suggested?—No.

1205. (*Captain Fisher.*) Would vessels in your opinion, making sail from a harbour constructed in Dover Bay make their passage down Channel under circumstances when they could not from a harbour constructed to the eastward of Dungeness?—Yes.

1206. (*Chairman.*) Are you a Deal man?—I was born at Deal, and now reside there.

[*The Witness withdrew.*]

*John Barber Thornton*, called in and examined.

Mr. John Barber  
Thornton.

1207. (*Chairman.*) What are you?—A Cinque Ports pilot.

1208. Where do you reside?—At Deal.

1209. Are you native of Deal?—No; I am a Dover man.

1210. If you were called on to construct a harbour for men-of-war to protect the trade, and at the same time for the accommodation of merchant-vessels, where between the North Foreland and Portsmouth would you have it?—Under the Brake.

1211. The harbour we are speaking of is intended to be accessible at all times of tide, and in all weathers, night or day, for large ships?—The Brake would be accessible at all times of tide at the southern extremity.

1212. What you mean to say is that you would have a work run out along the Brake Sand?—Yes.

1213. What is the general depth of water under the Brake at low-water spring-tides?—The regular soundings, commencing from the South Brake Buoy direct in shore to Sandown Castle are from 7 to 3 fathoms.

1214. Going further northward, what is the depth?—In a line with the first battery wall you have from  $6\frac{1}{2}$  to 3 fathoms.

1215. Do you bear in mind that the question as to a harbour of refuge was intended to mean a station for steam vessels-of-war to give protection to the trade of the Channel, and do you think the place you have named the most eligible situation for such a harbour?—I do.

1216. You think the place you have named lying more in the fairway for the protection of the Channel than any other?—I do.

1217. (*Sir Henry Pelly.*) Supposing a breakwater to be erected from Sandown Castle to the eastward, and another breakwater laid across towards the south buoy of the Brake on any portion of the line which would give additional shelter to all vessels lying therein, would not that make a highly improved harbour?—Yes; I think it would.

1218. Could there be one any better?—That is the view I have already taken of it.

1219. You were asked whether steam-vessels lying there could protect the Channel; you do not mean to say that steamers lying near Sandown Castle could protect Dover and Folkestone?—No.



Mr. John Barber  
Thornton.

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1220. All that you meant to say was that they would be a protection to the trade congregated in the Downs, but not to the Channel?—Yes.

1221. (*Lieut.-Colonel Alderson.*) Do you not consider that a breakwater, as before stated, constructed on a portion of the line between Sandown Castle and the South Brake Buoy without any breakwater on the Brake itself, would render the Small Downs a greatly improved advantage?—Yes; but not so good an anchorage as if a breakwater were constructed along the Brake itself.

1222. (*Sir Howard Douglas.*) If the Small Downs were converted into a harbour by breakwaters, would it be accessible under all circumstances of wind and weather, affording facility and safety of ingress and egress?—No.

1223. (*Admiral Dundas.*) In the event of war it would be necessary to have a harbour on the coast of Kent, as a rendezvous for war steamers to be sheltered from all winds and weathers to be constantly ready to slip out at a moment's notice for the protection of the trade and the coast, and to combine those objects with that of being a harbour of refuge accessible at all times of tide, and in all weathers, night or day; at what spot on the coast of Kent from the North Foreland to Beachy Head would you say such a harbour ought to be constructed?—I should say at Dungeness.

1224. In a gale of wind at S.W., is it your opinion that a powerful steam-vessel could get down from Dover to Dungeness?—I have seen many instances of fine steam-vessels putting back to the Downs, and men-of-war steamers could not get down in extreme cases.

1225. (*Sir Henry Pelly.*) Does not Dungeness at present afford shelter for men-of-war steamers to lie to the eastward when the wind is westerly, and to lie to the westward when the wind is easterly without any artificial works?—The East Bay affords very good shelter with the wind from N.W. to S.S.W., and the West Bay from N. to E.; but if there is any southing of east in the wind, there is no shelter in either Bay.

1226. (*Chairman.*) Dungeness having already naturally such extensive accommodation, would you, if a sum of money were laid down for a harbour of refuge, expend it there, or where there is less accommodation?—If I had got the money, I should go to the Brake Channel.

1227. But I am now speaking of the westward?—Then I should go to Dungeness, notwithstanding the present accommodation there.

1228. (*Captain Fisher.*) Is it your opinion that ships of the description, given you in a former question, seeking shelter in the harbour you propose inside the Brake from storms, or protection from the enemy, could proceed on their voyages outward or homeward, as the case might be, in all winds and in all weathers?—No.

1229. Is it your opinion that vessels making sail from your proposed harbour under the Brake, and the proposed one at Dungeness, could make their passages down Channel under all circumstances when they could from a harbour constructed in Dover Roads?—From a harbour under the Brake they could as well as from Dover, but they could not from Dungeness.

1230. Could vessels under all circumstance make their passages down Channel from either of the harbours you propose under the Brake or under Dungeness when they could from a harbour at Dover?—No.

1231. (*Chairman.*) Supposing the entrance to a harbour at Dover to be direct south, could a vessel get out of that harbour with a strong S.S.E. wind?—No.

1232. Looking at the plan before you, which of the entrances would you prefer?—The most westerly one.

1233. (*Admiral Dundas.*) Would it not be better to have the entrance more to the southward, when facilities could be given for ships to be tugged out?—No.

1234. What are the prevailing winds on this part of the coast?—South-westerly winds, and there is most sea with southerly winds.

1235. Supposing a gale of wind from the south, would you break a ship from her anchor to go down Channel?—I would not with the wind at south.

1236. Would you, in constructing a new harbour, prefer a spot like Dover when there are already facilities for the repair of ships in distress, or would you lay out money in so wild an anchorage as Dungeness, bearing in mind that the harbour would be constructed for steamers-of-war as well as merchant-ships?—I should prefer Dover, taking into consideration the facilities for repairs and so forth.

1237. (*Mr. Walker.*) What is your objection to Dover, supposing you to have any as compared with any other place?—Its being so much exposed to heavy seas in S.W. gales; and I think it would not be an easy roadstead for ships at anchor.

1238. (*Chairman.*) Do you think an entrance 700 feet wide would admit of the heavy sea you speak of?—Of course not, there would not be so much sea as there is now; but still the sea would strike against this harbour when formed with as much violence as now, which would come through this large space of 700 feet.

1239. Do you think a narrower space would be fit for navigation?—A narrower space would cause less sea within the harbour; but the entrance could not be too wide for the purpose of navigation.

1240. (*Mr. Walker.*) Looking at the objection to a very wide entrance by its admitting of heavy seas, and to the objection to a narrow entrance by difficulty of access and egress, what on the whole do you consider a sufficient width?—I should consider 500 feet plenty.

1241. Would you prefer an entrance to the southward for ships coming up Channel?—I should prefer a S.W. entrance. I consider two entrances would be necessary. One to



get egress with outward bound ships, and another to get egress with homeward bound ships.

1242. (*Sir William Symonds.*) I wish to know what you think of the holding-ground?—It is very good opposite the church in the valley; but in other places it is hard.

1243. From the opening which you recommend, would not the best ground be open to the wind?—It would if you were to run nothing out from the main shore.

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[*Mr. Wright*, resident acting engineer of the South-eastern Railway Company, attended to produce a model corresponding with Mr. Cubitt's proposed timber caisson or breakwater, which is the same as is shown in the drawing attached to the evidence taken before the Committee on Shipwrecks in the House of Commons.]

1244. (*Chairman.*) Have you anything to offer in explanation with respect to the model?—Nothing whatever.

[*The Witness withdrew.*]

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Commander *Mercer*, R.N., called in and examined.

1245. (*Chairman.*) You are superintendent of the Packet Service at Dover?—I am.

1246. How long have you been in that situation?—Three years in August next.

1247. Has your attention been much directed to the consideration of harbours on this part of the coast?—Not much.

1248. Are you prepared to say where you would consider the best situation for the construction of a harbour of refuge, in which a squadron of war-steamers might watch the opposite coast for the protection of the trade, such harbour to be intended at the same time for the convenience of merchant-vessels, to be made somewhere between the North Foreland and Dungeness?—I am decidedly of opinion Dover Bay would be the best situation for such a harbour.

1249. Do you know enough of Dover to speak of the anchorage in the Bay?—Yes; from the constant information I receive from the commanders of the packets, and having long lived in the neighbourhood.

1250. What do you understand to be the nature of the bottom?—To the westward of the Castle Jetty the holding-ground is considered to be fair, and in the centre of the Bay it is supposed to be tolerable.

1251. Are you acquainted with the coast further to the southward?—I have been at Dungeness, but I am not sufficiently acquainted with the soundings to give an opinion as to its eligibility as far as the soundings are concerned.

1252. (*Sir Henry Pelly.*) Have vessels which have been obliged to anchor in Dover Bay, when unable to get into the harbour, driven from their anchors?—They have driven, from not having been supplied with proper ground tackling.

[*The Witness withdrew.*]

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Commander *David Peat*, R.N., called in and examined.

1253. (*Chairman.*) Are you in command of the Coast Guard on this part of the coast?—I am.

1254. Where do you reside?—At Folkestone.

1255. Have you given much attention to the drift of the shingle, and what is the result of your observations?—I have not given the subject any particular attention, but it has come under my observation, and I have found its general movement is from west to east, and also that the tide seems to have no effect on the shingle, it being the gales alone that move it. I have noticed, that in the mouths of harbours, wherever there is an eddy of water or stillness, where the action of the sea has ceased to act on the shingle, there it rested. I have known at the mouth of a harbour, in one tide, from 100 to 500 tons to accumulate in one gale. This I have noticed at Dover, and also at Folkestone; and very lately, at the harbour of the latter place, sometimes 200 men were required every tide to keep clear the mouth of the harbour during a southerly gale.

1256. If you were called upon to say which would be the best position between the North Foreland and Portsmouth for a harbour for a squadron of steamers to be in time of war, for the protection of the trade of the Channel, and to watch the opposite coast, and, at the same time to serve as a harbour of refuge for the trade, what part along this whole coast would you propose?—If I were confined to one particular point, I must say Dungeness; but if two points, I should select Dover and Beachy Head.

1257. Might not the construction of a harbour or breakwater in the East Bay of Dungeness have a tendency to change the usual course of the tide, and by that means counteract the natural operation by which this projecting point of beach is lengthened out?—The shore is advancing there at present; but a breakwater out at a considerable distance, perhaps towards the Swallow Bank, might have a tendency to cause a greater run of the tide between the shore and the breakwater.

1258. In the last war, before steam was in use, and our squadron was watching the Flotilla at Boulogne, it was felt that an artificial harbour would be very convenient; but do you think the present anchorage is a secure and excellent station for a steam squadron, as it could move with great facility from one side to the other without any breakwater?—Yes; but there are eight points in the compass at which there would be no protection for steamers on either side of the Bay, and that would be the only thing necessary to find protection against.

Mr. *John Barber Thornton.*

16th May, 1834.

Captain *David Peat*, R.N.



Commr. David  
Peat, R.N.

16th May, 1844.

1259. But the necessity that existed during the last war would not exist in the same degree at the present time, when there are steamers?—Not quite.

1260. If a steam squadron were stationed at Dungeness, it would give protection, of course, to merchant-vessels congregated there?—Yes,

1261. Is ague prevalent on the flat lands at Dungeness?—The very point is salubrious, but, curiously enough, on either side of the Point, inland, it does prevail.

1262. Is there a good supply of fresh water there?—There is; but I am not able to say to what extent, or whether a large reservoir or excavations might not supply it to an extent. Near to the Point good and sweet water is to be had.

1263. Do you know enough of the locality to be able to say where stone could be procured in the neighbourhood, supposing a breakwater to be made towards the point of Dungeness?—It would require to be procured from either Fairlight, Hythe, or Folkestone. At the latter place there is a sea-wall, being built of excellent stone procured in the neighbourhood.

1264. (*Sir Howard Douglas.*) At what distance is Fairlight from the point of Dungeness?—About 10 miles,

1265. Could not steam-vessels pass on either side of the Point, to the westward of the Head, in the case of an easterly wind, or the reverse way in the case of a westerly wind?—Certainly, as long as the steamer could make headway.

1266. Do you think that the invention of steam, by enabling steam-vessels to pass from side to side, affords them a better anchorage than was available to sailing-vessels during the war?—Yes, I do.

1267. You specified Dover as a place for a harbour of refuge, in the event of two being constructed, of what extent should you imagine such a harbour ought to be?—I fancied it should extend from the South Foreland to Shakspeare's Cliff.

1268. To render the harbour easy of access, where would you propose to have entrances?—I should say not facing the S.W., because you would have a heavy sea rolling in. One good entrance to the south would prevent a heavy sea entering, because it would only be from the opposite coast, and consequently a short sea.

1269. Do you think a southern entrance would be easy of access at any time, and give a sufficient command of anchorage?—Yes, I do.

1270. (*Captain Washington.*) What should you consider a sufficient width?—300 yards.

1271. Where do you propose another entrance?—To the eastward.

1272. (*Chairman.*) Supposing a ship to be coming in in a heavy gale of wind, and the entrance placed in the centre of the harbour, when she runs to leeward so much, would she get in as easily as with the entrance placed more to the westward?—Certainly not; but unless a vessel was completely unmanageable, 300 yards would surely be sufficient to drive her in within the protection of the pier.

1273. Looking at the entrances on the plan before you, supposing a vessel to come in at the southern entrance in a heavy gale of wind, she must take advantage only of the lower part of the harbour, and cannot shoot up to the windward part to take her anchorage, if so would a southern entrance give a fair command in entering the harbour?—Certainly; it would allow her to have the whole drift of the harbour, and the south-west gale with her.

1274. If a ship were to enter with the wind blowing down the harbour, could she have the choice of the harbour for an anchorage?—Entering at the middle entrance, she would not have the advantage of the weather part of the harbour.

1275. (*Admiral Dundas.*) Bearing in mind that the one harbour to be constructed is to answer warlike purposes, as well as to afford refuge for merchant-vessels, would you, in constructing it, prefer a spot like Dover, where there is already facility for repairing ships and steamers, and other accommodation for vessels in distress, or would you lay out money in so wild an anchorage as Dungeness?—The protection would be greater at Dover, and the facilities for repairing ships would have to be created at Dungeness.

1276. If it were required to embark an army suddenly, could it be done with the greatest celerity from a refuge harbour at Dover or Dungeness?—At Dover, under the present circumstances, certainly.

1277. In a gale of wind at S.W., could a powerful steamer get down from Dover to Dungeness?—I have seen such a gale in which she could not. In such gales as happen about once in six years she could not.

1278. (*Sir Henry Pelly.*) Do not merchant-vessels congregate in large numbers in the Downs?—Yes, large fleets congregate in the Downs; and my reason for wishing a harbour of refuge at Dungeness is to save them running so far.

1279. Supposing there is no harbour of refuge between the North Foreland and Dungeness, where must vessels then congregate for safety. Do you think that they would, in war time, be able to get down to Dungeness without being attacked by an enemy?—Certainly; a harbour of refuge, with war-steamers at Dover, and another at Beachy Head, would afford greater protection.

1280. Should you think a capacious harbour of refuge at Dover alone would take in all those vessels which now congregate in the Downs, and if so made, whether it would not be a better place for a harbour of refuge than the Downs?—It is my opinion that Dover would be a better place than the Downs. Concerning the first part of your question, as to whether a capacious harbour at Dover only would be sufficient, within two months I have noticed about 100 sail of vessels pass to the westward. In two days a beating wind came on; they beat down till it came on to blow, when the whole of this 100 sail of vessels ran back



to the Downs; therefore I calculated that these 100 vessels, supposing they were to commence beating down again, would have lost much time, which they would have saved had there been a harbour to shelter them at Dungeness.

1281. On the whole, which do you think the best situation for establishing a harbour of refuge, taking all the circumstances into consideration?—Dungeness.

1282. Are you aware of the course from a harbour constructed at Dover to round the point of Dungeness?—W. and by S.

1283. (*Captain Fisher.*) Would or would not vessels, in your opinion, making sail from a harbour constructed at Dover, make their passages down Channel under circumstances when they could not from a harbour at the East Bay of Dungeness?—In certain winds Dover would have the advantage.

1284. (*Sir William Symonds.*) With your principal entrance to the southward, as I believe you have proposed, how would vessels outward bound be enabled to leave that harbour with a S.E. wind, that being favourable for them to proceed down Channel?—With an entrance of 300 yards wide any vessel, by shaving the weather pier or the eastward pier close, if not in a heavy gale of wind, would shoot out clear of the westward pier.

1285. Could she slip from her anchorage in any part of the harbour in a S.S.E. wind?—To the westward part of the harbour she could not, but to the eastward she might.

1286. You have been a long time in the navy, and in active service; if, coming in a man-of-war, knowing the situation of the Downs, would you be inclined to run into Dover projected harbour, formed as you see it on the plan, in order to bring up in a very heavy gale of wind, the harbour being embarrassed with a large number of merchant-vessels, if you knew that at least one-half of that harbour has a bottom of chalk, not holding-ground, and there being only 22 feet water in the centre of the harbour?—Under the circumstances stated, I would certainly prefer running and anchoring in the Downs, unless the gale was one which was right through the Downs; then, excepting with a very good pilot, I would run to Margate Roads.

1287. (*Captain Washington.*) In running a ship into such a harbour, with the choice of anchoring in seven or four fathoms, which would you anchor in?—I should prefer the seven fathoms.

1288. (*Sir William Symonds.*) Would you anchor anywhere if the ground were bad?—Not by choice.

1289. (*Chairman.*) Do you know anything of the soundings in Dover Bay?—I know a little about them.

1290. What is the nature of the ground?—It is considered pretty good holding-ground.

1291. (*Admiral Dundas.*) If you anchor in 6 fathoms water with the wind at S.W., would you not be driving up hill?—Yes.

1292. (*Sir Henry Pelly.*) Now supposing a harbour to be constructed on the east side of Dungeness, could you, with the wind at S.S.E., lay out so as to clear the Ness by it?—I think if the breakwater was a considerable distance from the shore, that with a S.S.E. wind I could still round the Ness Point; but in going out of Dover Harbour, there appears to be a point or two in the compass in favour of Dover.

1293. (*Mr. Walker.*) You stated that you would prefer two harbours to one; now, you know Dungeness is a harbour of refuge as it is, excepting certain winds (such as when to the S. of E.), and taking Dungeness as it is, and also Dover as it is, supposing a large sum of money about to be laid out, and at one place only, would you, under all the circumstances referring to the general question which has been put to you, prefer laying out that money at Dungeness or Dover?—I should say Dungeness.

1294. Supposing the harbour to be for armed steamers to be constantly on the look out for protecting the coast, would you prefer laying out the money at Dover or Dungeness?—There is greater protection at Dover, which would have to be created at Dungeness. If only one harbour were to be constructed, Dungeness would be something like in the centre, whereas a harbour at Dover would be at one end, the war-steamers would be ready to keep at Dungeness E. or W.; but if the only harbour were at Dover in S.W. gales, all the steamers would go there for shelter, and there would be no protection for trading vessels at Beachy Head.

1295. In the event of war, which do you consider the best stations on this part of the coast for steam ships-of-war to watch the cruisers of the enemy in their attacks upon our traders?—I should say about Dover and Beachy Head.

1296. (*Admiral Dundas.*) From what quarter have you the most severe and most frequent gales in the Channel?—From the S.W.

1297. Then, would you construct your breakwater at Beachy Head, at the W. or the E. side of the Head?—For protection from S.W. gales, I should say to the east of the Head.

1298. You prefer, as well as a breakwater to give shelter to the cruisers about Beachy Head, a harbour at Dover combining the purposes of commerce and war together?—Yes.

1299. Do you know anything of Newhaven?—Not much.

1300. What kind of holding-ground is there in Eastbourne Bay?—There is good holding-ground there.

1301. Do you know anything about the Sovereign Shoal?—I know something about it, but I cannot describe it distinctly.

1302. Is there plenty of room between the Sovereign Shoal and the shore for working the largest ship through?—I think there is not.

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Commr. *David Peat*,  
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1303. With Beachy Head light, and the light to be placed on the proposed breakwater, would you have any hesitation in running a ship in there in a S.W. gale?—I should have no hesitation in doing so, and I would by that means save running 70 miles to the Downs.

1304. In the event of a war, Beachy Head is the most prominent point for cruisers?—I think so.

1305. (*Admiral Dundas*.) Supposing it was determined upon to erect a breakwater near the east side of Beachy Head, what stone is there thereabout to erect it?—There is nothing but chalk in that neighbourhood.

1306. How would it stand the sea?—Very well, and it seems a compact fair good stone.

[*The Witness withdrew.*]

Lieut. *Matthew Coombe*.

Lieutenant *Matthew Coombe*, R.N. called in and examined.

1307. (*Chairman*.) In what situation are you?—I am a lieutenant in the Royal Navy.

1308. How are you employed?—On the Coast Guard Station, No. 2 battery, East Bay of Dungeness.

1309. How long have you been employed there?—Six years and four months.

1310. During that time how many vessels have you seen driven ashore in the East Bay of Dungeness?—During that period I have seen 12 or 13.

1311. Have you given much of your attention to the construction of any breakwater there?—I have.

1312. What is the result of your observations?—I have always thought that there ought to be shelter for shipping in the East Bay.

1313. Do you not think that the bay on either side, east and west, is a good and safe anchorage in its present state for a steam squadron to be stationed there, having the power on a change of wind to get up their steam and proceed to either side, without any breakwater being constructed?—No, I do not.

1314. Is not the West Bay a good anchorage, and much used?—Yes, in east winds, but the East Bay has the best anchorage.

1315. Is not Dungeness a good anchorage for steam-vessels?—Yes, as the wind may be.

1316. Do you know much of the coast between the North Foreland and Portsmouth?—I have not been in practice lately, but I formerly knew the coast; I commanded the “*Watchful*” cutter for two years, a tender to Captain M’Culloch, in the Blockade Coast Guard Service, and then I had a great deal of practice from the Downs to Beachy Head, but more especially about Dungeness.

1317. If you were called upon to fix on a place between the North Foreland and Portsmouth for a harbour to be constructed, to accommodate war-steamers to look out on the enemy, to afford protection to the trade in the Channel, and also as a port of refuge for merchant-vessels, what spot would you select?—If one harbour were to be constructed, I should select the East Bay of Dungeness; but if two were to be made, I should choose Dover also.

1318. In your cruises did you not consider Beachy Head an important position?—It is great in importance, but I never liked Eastbourne Bay.

1319. What is your objection to it?—The anchorage is not good.

1320. What is the nature of it?—There is a good deal of rock and foul ground about it.

1321. From experience, did you find it so?—Yes.

1322. Supposing the ground to be good, should you think the Royal Sovereign Shoal would be any obstruction to having a breakwater erected at Eastbourne?—None whatever.

1323. Is Dungeness an aguish place?—Yes it is.

1324. Have you had many of your men attacked with the ague since you have been there?—Not many; close to the lighthouse it is not so prevalent.

1325. (*Sir William Symonds*.) Is Dungeness much frequented by vessels bound up and down Channel?—It has been very much lately.

1326. How many vessels have you seen at any one time under the Ness?—I have counted upwards of 300.

1327. Do foreign as well as English merchant-vessels take pilots when bound to the eastward from Dungeness or from Dunkirk?—They have them off here.

1328. When the sea is violent enough to wreck vessels on the coast, is it so heavy as to break them up?—No.

1329. If a large breakwater were made 2 miles long in the situation shown you on this chart, would it be of advantage to that shipping?—It would be a safe anchorage for all shipping.

1330. Do you see the opposite coast from the Ness?—Yes, we do.

1331. If in time of war such a breakwater were formed with proper defences, do you not consider that it would be of great importance, in the event of the enemy making a descent upon that part of the coast?—Yes.

1332. Have you ever heard that the Ness was much frequented by privateers in the war time?—I was employed myself at the Ness in the war time, and I have been informed of that fact by a merchant who made his money by his privateers. As I was anxious to know as near as possible where the English shipping were captured, he informed me that he had two sets of privateers, one set at Ostend and Dunkirk, and the other at Havre. In strong S.W. gales he informed me that the Havre privateers were sent out with instructions to proceed to the offing of Dungeness, as it was probable the English men-of-war had returned to the Downs, and then they generally made their prizes.

1333. (*The Chairman*.) But under the present circumstances, as steam-vessels would be able to maintain their stations, the same danger would not exist?—Not to such an extent.



1334. Did the merchant tell you that all the prizes were made at Dungeness and not about Dover?—In easterly gales, when it was considered the fleet had left the Downs, and proceeded to Portsmouth, the privateers of Dunkirk and Ostend were sent out, and captured the shipping about the Downs and off Dover. I asked him where they took them to, when he said from off Dungeness they took the prizes direct to Boulogne; and from that I concluded that if a safe anchorage were made in the East Bay of Dungeness merchant-ships and ships-of-war could retire to it.

1335. (*Sir W. Symonds.*) How does the tide set from Dungeness?—From the point to the Foreland.

1336. How does the tide run from the point towards the coast of France?—There is an eddy to the S.E.

1337. As an old sailor, and having lived long at Dungeness, have you ever experienced a moment when a merchant-man could not, by going out of the lee side of the proposed breakwater, stand out sufficiently long to make a tack and weather the Ness, with the wind from S.S.W. blowing hard?—No.

1338. (*Chairman.*) Supposing, at the time you are speaking, a large convoy getting under weigh to proceed outward bound, do you think a merchant-ship could make that tack, the tack you are describing?—Standing on the starboard tack they could; but with the flood-tide I should doubt whether they would be able to do so.

1339. (*Admiral Dundas.*) In general could a powerful steamer get from Dover to Dungeness in south-westerly gale?—Generally it could.

1340. Bearing in mind that the spot to be selected for a harbour is for warlike purposes as well as a harbour of refuge, would you prefer a spot like Dover, where there is already facility for repairing ships and steamers, and other accommodation for vessels in distress, or lay out money in so wild an anchorage as Dungeness?—I should at Dungeness.

1341. If it were required to embark an army suddenly, could it be done with the greatest celerity from Dover or Dungeness?—From Dover.

1342. (*Captain Fisher.*) During the time that you have been resident on this coast, have you ever observed that vessels could sail and round the Ness when they would not be able to do so from the harbour you propose at Dungeness?—No.

1343. Could vessels with a strong wind from S.S.E. sail from your proposed harbour of refuge without working to windward?—They would require to make one board out.

1344. From your knowledge of the situation of Dover Roads could vessels with a S.S.E. wind round Dungeness without making one board, which you say would be necessary from a harbour at Dungeness?—Yes.

1345. (*Chairman.*) You say that 300 sail have sheltered under Dungeness at one time, you mean to give that as a proof of the general confidence of the trade in the present anchorage?—Yes, and they are becoming more confident every day.

1346. (*Lieut.-Col. Colquhoun.*) Where, in the time of war, do you think that steam-ships should be stationed to keep down the enemy's ships against our cruizers for the defence of the coast?—From Dungeness to Beachy Head.

1347. (*Capt. Washington.*) You have stated that the eddy-tide off Dungeness sets S.E. towards the coast of France; how far does it extend off shore, and how long does it run?—It begins about five miles off, and sets towards the coast of France.

1348. (*Mr. Walker.*) You stated that you have known from 12 to 13 vessels to have driven ashore in the East Bay while you have been on that station; were any of them wrecked?—Two of them were.

1349. Were they total wrecks?—They were so far considered to be so as to be sold for the benefit of the underwriters.

1350. What was the amount of damage done to the other 11?—The greatest damage was done to the "Beulah," which started a plank from off her garboard, after being on shore for eight days, with an easterly wind blowing strong.

[*The Witness withdrew.*]

Mr. John Iron, called in and examined.

Mr. John Iron.

1351. (*Chairman.*) What are you?—I am Harbour Master at Dover.

1352. How long have you been in that situation?—Twelve years.

1353. Were you bred to the sea, or what was your former occupation?—I have been to sea 55 years.

1354. In what situation?—I served my time in the merchant service, after which I was employed in the hired armed vessels in his Majesty's service till 1807, when I was a Cinque Ports pilot till 1832.

1355. It is your duty to be almost constantly at the pier-head of this place?—Yes, when ships are coming in or going out.

1356. What are the winds which bring the greatest accumulation of beach towards the harbour's mouth?—The winds from W.S.W. to S.W.

1357. Is there much accumulation at present about Shakspear's Cliff?—Round the point of Shakspear's Cliff there is but little.

1358. But if a gale were to come on from W.S.W., would the shingle appear about the harbour?—It would, but the shingle has been stopped by the late excavations connected with the railway-works, which prevented the shingle from coming round Shakspear's Cliff.

1359. But a south-westerly gale would bring it to the harbour again?—Yes.

1360. Does any shingle gather round the harbour when the wind blows from the East?—None.



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1361. How long has it been blowing from the eastward?—About three weeks.

1362. There appears at the present time, by the eastern pier, to be a considerable quantity of shingle; is that always there?—No, it is within the last ten weeks that it has been driven away by the sluices; and the westerly winds have taken it to the back of the East Pier.

1363. When the entrance to the harbour is clear of shingle at spring-tides, for how many hours would there be ten feet water at the rising and the ebbing of the tide?—About five hours on the average.

1364. What is the quality of the bottom in Dover Bay?—There is gravel, sand, and clay in different parts of the bay.

1365. How would you describe the holding-ground, is it good, bad, or indifferent?—It is very good in some parts, and in others indifferent. About the Valley it is very good, but not so good in other parts.

1366. Do fishermen trawl in the bay?—There is no trawling-ground there.

1367. Are there rocks in the bay?—None, except close in shore.

1368. Have you ever known any vessel ride out the gale with the wind on shore?—I do not recollect any particular circumstance; but I believe about 55 years ago a collier did so, without starting.

1369. Are you generally in attendance when vessels are standing in for the port in bad weather?—Generally.

1370. Is it very frequent in such weathers that vessels seeming desirous to take refuge in Dover Harbour are deterred from entering on account of the shingle?—We haul down the flag if it is not prudent for them to enter, sometimes on account of the bar, and at other times on account of the sea; and if there is a heavy bar, we do not hoist the flag, indicating that vessels may enter.

1371. Supposing an artificial harbour to be constructed, enclosing Dover Bay, should you have any doubt as to the holding-ground?—I should have no doubt but that ships would hold in any weather.

1372. Do you consider that vessels wishing to take shelter in south-westerly gales would prefer running to the proposed harbour in Dover Bay, or running to the Downs?—I should think they would prefer the harbour of refuge.

1373. Has there ever been, at any time within your knowledge, any boring of the bay, to know what it is?—Not in the bay, but just in the harbour; and outside of this I cannot give any information; but there is an engineer who can.

1374. Can you state the number of vessels that have entered this harbour in any one year on the average?—In 1834, 1,067 coasters and British and foreign vessels, not including fishing-vessels; and in the same year 1,373 steam-packets and passage-vessels. In 1842, there were 1,298 coasters and British and foreign vessels, exclusive of fishermen; and 1,509 steam-packets and passage-vessels. In 1843, 1,286 coasters and British and foreign vessels; and 1,612 steam-packets and passage-vessels.

1375. Supposing an artificial harbour to surround the present harbour, would it be great accommodation if the present harbour were converted into a wet-dock?—It would, for loading and unloading.

1376. What is the whole extent of the wharfage you have round your basins, supposing your harbour to be shut in as a wet-dock?—6,559 feet, as the harbour stands at present, independent of the improvements about to be made.

1377. If there were an artificial harbour formed, and an enclosure to take place, would you make any suggestions as to getting rid of the silt and the back-water?—It would require to be carried out to the westward of the artificial harbour under the street, and I do not know that there would be any difficulty in doing so.

1378. Supposing a breakwater to be placed in Dover Bay, according to the plan which is now shown to you (*Mr. William Cubitt's Plan, laid before the Shipwreck Committee, 1843, Report, page 261*), do you think an entrance at each end would be desirable?—I do not think that would be desirable at all; I think the beach would come in at the western entrance.

1379. Do you think that the beach would pass through and lodge?—I think it would come into the bay and fill it up, and there would be no means of getting it out.

1380. You do not think it would be carried through the harbour?—No.

1381. Looking at the plan now placed before you, showing three different lines of breakwater, which of the three entrances described would you prefer?—I should prefer the outer line of breakwater, and the southern entrance.

1382. If an entrance were placed where you point out, and ships were coming in with a heavy gale of wind, would it not prevent their taking advantage of any other part of the harbour, excepting the eastern part of it?—There is no doubt but that it would.

1383. What is your objection to the western entrance?—I think there is more chance of shingle going in than at the southern.

1384. But supposing there was no risk of the shingle going in at all, then which entrance would you prefer?—Then I should prefer the western.

1385. Do you believe, from your experience of the shingle, that in a depth of seven fathoms water, at low-water spring-tides, any shingle would get there?—I think in the course of years it might. I have an idea that if there is any light substance to come along shore, a gale would bring it over, if it were chalk.

1386. Looking at the plan, with the breakwater coming out from Cheeseman's Head to the extent shown on the plan, would not that carry the shingle into deep



water?—I believe that the shingle would fill up there in the angle, from Cheeseman's Head to the elbow of the breakwater, and would then go on till it came to the western entrance, and then turn into the harbour.

1387. Would there not be the same effect were the entrance at the south?—There is no doubt of it, in the course of time.

1388. Then you do not believe that the action of the shingle is confined between high and low-water mark?—I do.

1389. Then in that case how can it approach the entrances in a depth of seven fathoms?—It will make shallow water as it accumulates.

1390. Do you think, in a depth of seven fathoms, that will be the case?—I think it will.

1391. How long will it take?—It depends on whether there is any means taken, such as jetties to stop it.

1392. You do not believe that that kind of breakwater, throwing the beach into deep water, would prevent its accumulating?—No, I do not.

1393. Supposing a ship to be coming up Channel, with the wind at W.S.W., which entrance would you consider the best to be left open for her to enter?—In a harbour of this extent I would have one as soon as the other.

1394. If you were in charge of a ship coming in, which of these entrances would you consider as giving the greatest command?—The weathermost one.

1395. (*Admiral Dundas.*) Supposing the harbour to be full of shipping, and a ship coming in from the S.W. in a gale, would she deaden her way quicker by coming in at the middle approach than in the south-western one?—In the middle or south you may do what you like with your ship.

1396. (*Chairman.*) Supposing a ship to be coming in with a heavy gale, does that not unavoidably oblige her to go into the lee part of the harbour?—Yes.

1397. Then a multitude of ships, if coming in under the same circumstances, would all be driven into that corner?—They would all be obliged to take the lee part of the harbour.

1398. What breadth would you have between the pier-heads for an entrance?—Not less than 1000 feet.

1399. For what purpose do you require so great a breadth?—In bad weather there would generally be a heavy sea before a harbour of this description, and there would also be a strong tide.

1400. But would not a space of 700 feet be sufficient for any ship to shoot into that harbour?—No; with merchant-ships you are generally short-handed, and the sail is required to be got in.

1401. Would you have a second entrance?—I do not see much utility in it.

1402. If there were no other entrance than the one you propose, would not the harbour be likely to silt up?—As far as regards silting up, you would require another entrance; but it would not be necessary for the shipping.

1403. Would not the second entrance afford greater facility in getting in and out?—I do not see that you could not get in almost as soon at entrance A 3 as at an eastern one.

1404. Then to prevent accumulation of silt, you would have two entrances; but for the shipping only one?—Yes.

1405. Then as you are apprehensive that the shingle would come into the harbour, you would rather have no harbour of refuge at all at Dover?—It is not for me to say whether we should have one or not; I was only speaking on the supposition that nothing could be done to the westward in the first place to prevent the shingle coming along the coast.

1406. Something would certainly be done by the proposed extension of the pier from Cheeseman's Head?—That would certainly be of some effect.

1407. (*Admiral Dundas.*) Supposing an entrance at S.W. to be made of 1000 feet in width, would there not be a heavy sea roll in?—Yes.

1408. Would there be less sea with one at south?—Certainly.

1409. Now a ship lying at the east side of the harbour, wanting to get out, must work up before she can do so if the wind was westerly?—Yes.

1410. Then would not a small passage to the eastward be a good thing?—Yes, it might be of some benefit; but there is a heavy tide which runs direct in shore.

1411. Supposing a ship gets under way with a westerly wind, a leading wind, bound to the eastward, would it not be a great convenience to her if there were a small entrance to enable her to get out at the entrance, and especially as her having a leading wind would prevent the tide having much effect upon her?—It would be of some benefit.

1412. (*Sir Howard Douglas.*) Do you think, with all your experience, that this bay may be constructed into a harbour of refuge accessible at all times of tide and in all weathers?—I think it could.

1413. (*Chairman.*) If you were called upon to give an opinion as to the best position between the North Foreland and Portsmouth for a rendezvous for war-steamers to protect the trade of the Channel, and at the same time to give shelter to ships navigating the Channel, on what spot between these two points would you fix?—Dover Bay.

1414. Do you think that enclosing Dover Bay is desirable at a great cost of public money?—I think it the most desirable place between the two points named.

1415. (*Sir Henry Pelly.*) You know the Downs pretty well?—Yes.

1416. Supposing that an equally commodious harbour could there be made for the trade coming down from the river, would Dover or the Downs be the best situation?—Dover would be the most convenient for the trade.

1417. (*Captain Fisher.*) With your knowledge of the anchorage in Dover Roads, would

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you have any hesitation in running a vessel for security into any harbour that might be constructed there?—Not in the least.

1418. Would the entrance you prefer enable vessels to leave that harbour in winds the most to the southward that would allow outward bound ships to make their passage down Channel?—It would allow them to do so.

1419. Without an entrance to the eastward, which you rather objected to, how would ships detained by stress of weather go to their destination even when the wind was fair?—I see no difficulty in the case of their doing so.

1420. With your knowledge of the coast, are you of opinion that vessels from a harbour constructed in Dover Roads could make their passage down Channel under extreme circumstances, when they might be prevented going to a harbour on the east side of Dungeness?—Yes.

1421. Are you a native of Dover?—No; but I have resided there from a boy.

1422. (*Sir W. Symonds.*) Supposing a fleet of merchant-men to be coming from the Thames, and prevented going down Channel by the prevalent westerly winds, such a fleet would, as things are, stop in the Downs; and if a harbour of refuge were constructed in the Downs, they would be able to take shelter in it; but supposing a harbour to be constructed at Dover, how would ships such as I have described reach that harbour?—In one tide they would be able to reach a harbour of refuge constructed at Dover, if it did not blow too hard.

1423. Supposing it to blow a strong breeze of wind, could they do so?—If I found a strong wind at S.W., in coming down the river, I should anchor in Margate Roads, where I should already have a good roadstead.

1424. Of ships in the situation I have described, do the greater number stop in Margate Roads or come to the Downs?—With a S.W. wind, the greater number remain in Margate Roads; but with westerly winds, the greater number come to the Downs.

1425. They could not get round the Foreland with a strong S.W. wind?—No.

1426. Do you consider, for a fleet of merchant-men coming down Channel with a S.W. wind, Dover is a better situation for their taking shelter than the Downs, if they could reach Dover?—They could not reach Dover in a gale of wind from S.W.

1427. What is your opinion of Dungeness, in its present state, as a shelter for shipping?—It is an open roadstead in its present state.

1428. Do you consider it at present a safe position for steamers to remain at?—Not with the wind at all points of the compass.

1429. (*Mr. Walker.*) A good deal has been said with regard to the shingle in front of Dover harbour; I wish to ask you whether you consider the harbour has derived important benefit from the sluices of late years?—Great benefit.

1430. When did they come into operation?—In the autumn of 1837.

1431. Has the entrance to the harbour been nearly as much impeded by the shingle since that period as it was before?—Not at all; before, it was blocked up for seven or eight days at a time; but since, it has never been blocked up more than two or three days.

1432. Has it ever been blocked up for two or three days at a time by the shingle alone since the sluices were opened?—It was blocked up for two or three days, but not from the bar alone, during the heavy gales of January and February, 1840.

1433. When, after 1840, was it blocked up again?—We have not had it blocked up since for more than a day or so.

1434. What do you conceive, from your previous knowledge of the harbour, would have been its state during the gales of January and February, 1840, if the sluices had not been in action?—It is likely it would have been stopped up for 14 days, and perhaps longer.

1435. Do you consider that the shingle you have had since the great fall of chalk to the westward of Shakspeare's Cliff was shingle that was previously on the eastward of Shakspeare's Cliff?—Yes.

1436. Then do you think that the chalk which has been removed into the sea by the railway works has prevented the shingle from coming from the westward?—I do not think any shingle from the other side of Shakspeare's Cliff has come this way since the operations of the Railway Company; and the excavations that have been thrown out into the sea have caused the chalk to come along the shore in gales of wind, and mix with the shingle, so that it has become cemented together, and rendered it more difficult of removal from the mouth of the harbour.

1437. Have you had an opportunity of noticing the accumulations that have taken place to the westward of these projections of chalk in the sea between Folkestone and Dover?—I have not.

1438. Am I correct in saying this, that if it were possible by some contrivance to fix all the shingle that lies between Shakspeare's Cliff and the mouth of the harbour, or to remove it, you would have no shingle at all in front of the harbour?—None; that is my opinion.

1439. Do you think that all the shingle that annoys you travels between high and low-water mark?—I do; I think that no shingle travels below low-water mark.

1440. If this is the case, will you explain to the Commissioners what you mean by saying that in the course of time the shingle would be likely to accumulate in front of the entrance of the proposed harbour of refuge, when that entrance is in a depth of six or seven fathoms at low water?—The shingle comes along shore until it meets the obstruction of the pier; there it falls down, and keeps extending out, and shallows the water as it keeps accumulating.



1441. (*Chairman.*) What charges are ships liable to at Dover?—From 3*d.* a ton to 1½*d.*, and the difference depends on the commodity with which they are laden.

1442. Are ships coming in for refuge liable to the same charges as are paid by those discharging cargoes?—I think so.

1443. What distance is the shingle driven away by the sluices?—It depends on the lowness of the tide. At low tide, it will be taken 50 feet from the sluices.

1444. Does the rock at the entrance of the harbour there obstruct it?—There is no rock there. All sluicing power after the water finds its level loses its effect.

1445. Are you of opinion that the harbour is capable of being improved?—Enlarging the present outer harbour, and making a gate-way 60 feet wide into the Pent, will be the means of admitting large steamers into the Pent, where they could not go in safety before.

1446. (*Admiral Dundas.*) Are you at great expense in sluicing?—About 120*l.* a-year.

1447. Would that expense be entirely saved if you had a harbour of refuge outside?—Yes; we would then have no occasion for sluicing.

1448. (*Chairman.*) Could the sluicing power be applied in any other way for a useful purpose?—I do not think it could.

1449. (*Sir Howard Douglas.*) In such a gale of wind at S.W. as merchant-ships could not break ground from the Downs to get to the proposed harbour of refuge at Dover, would that be a probable time for an enemy to make an attack?—I should think not.

1450. And could not, with that wind, English war-steamers leave Dover for the protection of the trade with the most perfect ease?—Certainly they could.

1451. The constructing of a harbour of refuge outside the present harbour would enable you to improve your inner harbour to a very great extent?—Yes, it would.

1452. By deepening the present outer harbour by excavation?—We could deepen the whole of the present harbour.

1453. Would the foundation of the present harbour allow you to do so?—Yes; it is chalk.

[*The Witness withdrew.*]

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Mr. *William Basden*, attended at his own request.

Mr. *William Basden.*

1454. (*Chairman.*) Are you residing at Dover?—Yes, I am; I have resided here for the last two years.

1455. In what situation are you?—As purser of the Packet Service.

1456. You have desired to see the Commission on some subject, what is it?—To present a small model.

1457. Will you explain your object?—[*Witness here handed in a written explanation of his model.*]

1458. (*Sir Howard Douglas.*) Have you any idea how long the wood would last?—If we may judge from the wreck of the “*Royal George*,” it would last for a great many years; and even the rotting of the timber would be of little consequence.

[*The Witness withdrew.*]

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Mr. *Luke Smithet*, R.N. called in and examined.

Mr. *Luke Smithet*, R.N.

1459. (*Chairman.*) In what situation are you?—As commander of Her Majesty’s steam-packet “*Princess Alice*.”

1460. How long have you been employed in the Packet Service?—I have been 22 years on this station.

1461. Should you find it of great benefit to have an artificial harbour surrounding the present harbour of Dover?—I should, very much.

1462. Putting aside the convenience you would feel on account of your own vessel being at this port, which, as an experienced man, would you consider the best place on this part of the coast for the construction of a harbour of refuge, to give protection to the trade in blowing weather, and also for a squadron of steam-vessels in time of war to render protection to the trade of the Channel, and to watch the motions of an enemy?—Dover Bay, in this point of the Channel, because it is nearer the opposite coast than any other place, and, in blowy weather, ships might approach and enter at all times by day or by night.

1463. You said that this port is nearer and more convenient for watching the opposite ports; Dungeness is nearer Boulogne than this?—Very little; the difference in distance is not worth a question, and with an ebb-tide it would be the same.

1464. You would prefer Dover, and think it a more eligible place than the Downs for the purposes enumerated, and more preferable than any other part between the North Foreland and Portsmouth?—I consider it so for war purposes, as well as for the shelter of the trade in time of peace.

1465. Dungeness having a good harbour at present on each side of it, is it your opinion that money would be more advantageously laid out on a harbour here than on one at Dungeness?—Yes, on account of Dungeness having two roadsteads, one in the East and one in the West Bay.

1466. Is it your opinion that, having these natural advantages, money would be better expended elsewhere in providing a harbour?—Yes.



Mr. Lake  
Smithet.

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1467. The plan now put before you represents three lines of breakwater in front of Dover; the first is in six fathoms, the second in seven fathoms, and the third on the outer edge of the seven fathoms; which of these three, in point of extent, would you prefer?—I would prefer the largest, as giving more general accommodation.

1468. You see in these projected breakwaters three different entrances, marked A 1, A 2, and A 3, which would you prefer?—I consider A 3 the best for the centre entrance.

1469. Supposing A 3 to be adopted, would not the benefit to the shipping be confined to the lower side of the anchorage?—Yes.

1470. Will the entrance at A 3, always bearing in mind that we are supposing a gale of wind, give the greatest command of the anchorage?—It would.

1471. Supposing a convoy of 100 sail to be coming for the harbour, would not this entrance at A 3 force them into the lower part of the harbour?—It would, and they would be safer there.

1472. Would you approve of two entrances?—Yes.

1473. What space between the pier-heads of entrance A 3 do you consider would be sufficient?—From 700 to 900 feet.

1474. Of what breadth would you have the eastern entrance?—From 250 to 300 feet.

1475. Have you any movement of the shingle at Dover?—A good deal.

1476. Suppose you have an entrance at A 3, would you have any apprehension of the shingle getting in there?—No, I think it would not travel in deep water. I do not believe the shingle would come to A 3 entrance to as to affect the harbour.

1477. (*Admiral Dundas.*) Would it not disturb the anchorage of the harbour to have an opening to the S.W.?—Very much; and it would also admit the shingle sooner into the harbour; and if it were admitted you would be unable to get it out.

1478. Supposing a ship to be coming in before the wind at the S.W. entrance, must she not wind round to come through?—Yes.

1479. Would she require more room to haul up to an anchorage than if she came in at the south-eastern entrance?—Yes.

1480. With a gale at W.S.W., and a ship hauling round the western head of the S.E. entrance of the projected harbour, how would she lie up?—at N.W., and fetch into shelter.

1481. (*Chairman.*) When you talk of a ship hauling up in a gale of wind, how can she lie up to get her anchorage?—At N.W., which would fetch her into shelter.

1482. (*Captain Fisher.*) With your knowledge of the bottom of Dover Roads, would you have any hesitation in running in a vessel there which might be committed to your charge for security in very bad weather?—No.

1483. Would the entrance you prefer enable vessels to leave the harbour in bad weather in such winds at the most southerly point that would permit them to make their passage down Channel?—I should think most vessels would be able to turn out with the wind right on shore. The reason is, there is little or no sea from S.E. and S.S.E. winds.

1484. (*Chairman.*) Supposing vessels are entering this proposed harbour at No. 3 entrance, wishing to go to the inner harbour, would they fetch in?—No, they could not.

1485. Taking any other entrance, would they?—Yes; at the western they would.

1486. (*Admiral Dundas.*) In all weathers could a powerful steamer get from Dover to Dungeness?—There is not perhaps twice in a year that she would be prevented from starting.

Captain  
Hamilton, R.N.

1487. The chairman here addressed Captain Hamilton, R.N., of Dover, who was present during the examination of last witness. You have heard the evidence which has been given by Captain Smithet?—Yes, and I approve of all that he has said.

[*The Witness withdrew.*]

Mr. Richard Moull.

Mr. Richard Moull, called in and examined.

1488. (*Sir William Symonds.*) Are you a Dover pilot?—I am.

1489. How long have you been acting in that capacity?—I have been 29 years a Cinque Ports pilot, and 7 years in the navy.

1490. Are you a Dover man?—Yes, and was born there.

1491. If a large and extensive harbour were to be created between Portsmouth and the North Foreland, to serve as a rendezvous for a squadron of war-steamers to protect the Channel, and as a harbour of refuge for the trade, where do you think would be the most desirable situation?—I know of no place to protect the shipping from all winds except such a harbour were to be carried round in Dover Bay on an extensive scale.

1492. (*Sir Howard Douglas.*) How many entrances would you have for such a harbour, and where would you place them?—I should only propose two, one at the westward end (A 1), and an eastward one.

1493. (*Admiral Dundas.*) What space would you required between the pier heads?—It should be at least a quarter of a mile. A ship entering at A 3, in a strong gale of wind could not possibly be brought up in time if she were even to let go both her anchors, because she would have to carry a great deal of canvass, on account of the rapidity of the cross tide, to give her way enough for entering the harbour.



1494. Would she have more way going down before the wind and sea, or hauling up on the larboard tack?—Not so much, because she would have most of her canvass stowed, and the whole of it as soon as she passed the entrance of the harbour.

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1495. Would the harbour be more tranquil with an opening 1000 to the south-west than it would by being open to the southward only?—The harbour must be formed with an elbow, otherwise the sea will sweep into it.

1496. But if there was a southward entrance, would no sea at all run from the west?—I should think there would be more.

1497. How could there be more sea with a southward entrance than with a S.W. approach?—I should suppose, in forming the harbour, the mouth of it would lie to the westward, and not to the S.W.; and then so as to form an elbow coming out to the S.W.

1498. Would the shingle come in from the westward?—The shingle has travelled beyond the skill of any one to form an opinion, from what I have seen.

1499. Would not the shingle be more likely to come to the western entrance than if the opening was to the southward?—I should think not, provided that the inner pier was carried to the extent of the rocks. If it were carried into 7 fathoms water, I should think it impossible for the shingle to come in.

1500. (*Sir William Symonds.*) What sort of holding-ground is there in Dover Bay?—Not very good.

1501. (*Sir H. Pelly.*) From the knowledge you have of the anchorage-ground of the proposed harbour at Dover, would you have any objection to running a vessel into it for security in bad weather?—Not in the least, as regards the ground.

[*The Witness withdrew.*]

Lieutenant *B. Worthington*, of Dover, examined.

Lieut. *B. Worthington*.

1502. (*Chairman.*) Have you given much consideration to the subject of Dover Harbour?—I have given attention, and have written upon the subject. I was called upon to give evidence before a Committee of the House of Commons in 1836, and the Commission appointed by the Government, under the direction of Admiral Sir James Gordon, in 18 .

1503. Supposing you were called upon to name an eligible spot for a harbour of refuge, between the Thames and Portsmouth, what would you name?—Supposing other sites equally eligible in point of situation, I should name Dover.

1504. What is your opinion of the anchorage in Dover Bay?—The holding-ground is very good in Dover Roadstead; ships anchoring with St. James's church tower on with Old Park in the Valley, with the South Foreland Lights open, in from 10 to 14 fathoms water, scarcely better holding-ground is to be found in the English Channel; the marks I have stated is a berth for large ships; small vessels usually anchor in the Bay, where the ground is compact sand, and in some parts chalk.

1505. You have described one particular part with certain bearings, but what do you consider the general nature of the holding-ground?—No foul ground, and the whole of it good holding-ground; I confine this observation strictly to the limits of Dover Roadstead.

1506. Can a powerful steamer get down from Dover to Dungeness, the wind blowing hard?—It must blow particularly hard to prevent her.

1507. Suppose a breakwater to be constructed in seven fathoms water, how many openings would you have?—Supposing the breakwater to extend from the shore, three.

1508. Do you speak of your own knowledge of the holding-ground in Dover Bay?—Yes, from my own knowledge, from early experience; although of late years I have not been engaged in the Channel; circumstances may have altered, but I have no reason to suppose they have.

1509. (*Admiral Dundas.*)—Can a powerful steamer get down to Dungeness if blowing hard?—It must blow very heavy to prevent her doing so, especially with an ebb-tide.

1510. Supposing a breakwater constructed in front of the inner harbour, how many entrances would you recommend?—If projected from the main land, three; the one to the south-east to admit the ingress and egress of a line-of-battle ship under all imaginable circumstances.

1511. Taking into consideration the prevailing winds, where would you place the western entrance?—In the south-west side.

1512. And where would you place the third?—To the eastward.

1513. Would you recommend a pier from Cheeseman's Head to be extended to the north end of the breakwater so as to shut out the shingle?—I think I should not do so; the question brings to my mind many serious and conflicting considerations, both as regards what may be the future results from the erection of the contemplated harbour of refuge and to the present port, as well as to the welfare of the town, by shutting in the Bay with a breakwater: I think I should be inclined to decide upon detached breakwaters, leaving a free navigable channel in shore, with not less than three fathoms water low spring-tides. Dover Bay is land-locked, viz., from east to west, or one half of the horizon; therefore the question resolves itself into the consideration of the best mode of giving shelter to the



Lieut. *B. Worthington.*

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other and exposed half, by constructing a work that will create no dangers, nor injuriously change existing establishments.

1514. (*Captain Fisher.*) During the time you have been at Dover, have you seen many or any vessels driven from their anchors while riding in the Roads?—Never, to avoid coming upon the shore, it is my opinion that many ships drive, not from bad holding-ground, but from defective and inefficient ground-tackle, and from the want of proper care; sometimes it is observed that ships ride through heavy gales when it was expected they would not do so; at other times ships drive, or part when there was no apparent cause.

1515. (*Captain Washington.*) Suppose you were called upon to say why you give the preference to Dover Harbour?—There are many considerations to induce me to name Dover; first, its defences as a military station; second, its internal accommodation. The present harbour to a great extent would supply the place of docks; and many light craft seeking refuge would come inside, when the outside became too crowded.

1516. What is your opinion of the holding-ground?—I have always understood the anchorage cannot be better; referring to the marks I have before stated, it is excellent anchorage in clay or mud; not better holding-ground in the English Channel.

[*The Witness withdrew.*]

May 17th, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Mr. *E. K. Calver.*

Mr. *E. K. Calver*, Master and Assistant Surveyor, H.M.S. “Blazer.”

1517. (*By the Chairman.*) How long have you been employed in surveying?—Eight years; three afloat, and part on shore.

1518. In sailing through the Brake Sand the other day, did the depth of water agree with your expectations?—There appeared to be a less depth by three or four feet throughout.

1519. Should you think the anchorage within the Brake a fit place for a harbour for a squadron of ships-of-war and a refuge for the trade?—Not at all fit.

1520. As a seaman, and being intimately acquainted with the coast, what place between the North Foreland and Portsmouth do you consider the most desirable as a rendezvous for a squadron of steamers-of-war, for the protection of the trade of the Channel, and to serve as a place of refuge for the trade?—Dover.

1521. You were employed in surveying the East Bay of Dungeness?—I was.

1522. Do you consider it a favourable place for the construction of a harbour or breakwater?—No.

1523. And why not?—Because it offers no available space within a moderate distance off shore. Also because you merely improve upon a naturally good roadstead.

1524. Does the water suddenly deepen in the direction of the Swallow Bank?—Yes.

1525. In what depth of water would a breakwater be placed if constructed one mile from the beach?—In a general depth of two fathoms.

1526. At what distance from two fathom soundings would you find seven fathoms in low-water spring-tides?—One mile.

1527. Then a breakwater, placed in seven fathoms low-water spring-tides, would be two miles from the shore?—Yes.

1528. Is the anchorage on each side of Dungeness as it now is, without a breakwater, a good anchorage for a squadron of steamers, they being able speedily to move to either side on a change of wind?—Very good.

1529. To what winds is the anchorage now exposed, including both sides?—From east and by south; south about to south-west, 11 points.

1530. Have you been lately employed in making a detailed survey of Dover Bay?—I have.

1531. In making the survey, how often have you anchored in Dover Bay within the last month?—Eight or ten times.

1532. Having anchored so often, you will be able to state accurately the quality of the bottom as a holding-ground?—Good in smooth water only.

1533. Should you consider it a safe and good holding-ground if surrounded with a breakwater harbour in the worst weather?—Yes.

1534. What anchors is the “Blazer” supplied with?—Porter’s.

1535. In breaking the anchors out of the ground during the several times you anchored there, did you find they had a good hold?—They always brought up chalk.

1536. Did you at any time, either then or previously, anchor there when it was blowing strong from the south-west?—Never to my recollection.

1537. You have served a great deal at Harwich and surveyed the harbour and anchorage?—I have.

1538. Do you think anything can be done there to make it a safe anchorage for a squadron of ships-of-war?—Easily, at a small expense.

1539. By what means would you effect this?—By joining the Cliff-foot Rocks to the



Beacon Cliff by a slight breakwater, its extent being about 800 yards or less, and dredging away the corners of the shoals in the eastern channel.

1540. (*By Sir Howard Douglas.*) Did you ever find difficulty in heaving up your anchors in Dover Bay?—They never had hold enough to cause any difficulty.

1541. Do you not consider that as the general quality of the ground, and as denoting the measure of good holding-ground?—I consider it a good test.

1542. (*By Admiral Dundas.*) Is the holding-ground in Dover Bay more inclined to chalk to the east of the Castle Jetty than to the westward?—Well, out in deep water, it is.

1543. How many entrances would you recommend for a harbour before Dover, and if two, where would you place the western entrance, so as to prevent the south-west sea and the shingle from rolling in?—I would have two. The southern entrance should be passed by the west-south-west wind at as near a tangent as possible, that being the heaviest sea.

1544. Would there be any difficulty or danger, supposing the southern entrance was 700 feet wide, for any vessel to enter in or go out across the tide, and in a strong breeze of wind from west-south-west?—But little; and I consider that it would be quite removed if made wider, say 300 yards at high water.

1545. How far from the eastward of Cheesman's Head would you have your principal entrance to the harbour?—Nearly half the extent of the harbour.

1546. (*By the Chairman.*) How does the quality of the bottom at Dover compare with the general anchorage in the Downs?—Inferior to the Downs.

1547. (*By Sir H. Pelly.*) You stated the anchorage in Dover Bay as good in smooth water only; what do you mean by good?—I mean good for smooth water; but directly a lift occurs, it is so no longer; but if surrounded by a breakwater, I consider it would be good under all circumstances.

1548. (*By Captain Fisher.*) In making your survey of Dover Roads, what was the general nature and quality of the bottom?—Within seven fathoms, chalk, with a smooth surface here and there covered with ross, an animal substance or worm cast.

1549. Were you in Dover Bay during heavy blowing weather, with wind from the southward and westward?—Never.

1550. What is the set of the tide in the line of the proposed breakwater?—The outer part east by north, and west and by south.

1551. Are you of opinion that vessels seeking shelter in a harbour constructed in Dover Roads could proceed on their voyages out or homeward as may be, in all winds and all weathers?—Easily, under all circumstances.

1552. Are you of opinion that ships seeking refuge could make their passage down Channel under circumstances that would prevent them from doing so, from a harbour in Dungeness East Bay?—Yes.

1553. (*By the Chairman.*) Where would you propose an eastern entrance to a harbour at Dover?—In from four to five fathoms at low water.

1554. (*By Lieut.-Col. Colquhoun.*) Would the eastern entrance be affected by the tides?—It would be nearly still water on flood and ebb.

1555. (*By Sir William Symonds.*) Did you ever anchor in a sailing-vessel in a heavy gale under Dungeness with winds from south-west to west-north-west?—I have.

1556. In very heavy gales?—In gales of a general nature during the winter.

1557. Did you ever find the anchorage good?—Yes.

1558. Both as a shelter and as a good holding-ground?—Yes.

1559. Were you ever at anchor on the west side of Dungeness in a heavy gale from east to north-east?—Not to my recollection.

1560. For what period have you ever been in active employment in sailing-vessels using the narrows belonging to sailing ships?—During the principal part of the winter of 1832, cruizing for Dutch merchantmen.

1561. In what ship?—The "Satellite," Captain Robert Smart.

1562. Did you keep the sea in all weathers?—Yes, either about Dungeness, or on the Dutch coast.

1563. How long were you at sea during that period?—With a very few exceptions, from October to the following spring.

1564. You say that in smooth water the holding-ground off Dover is good; is it equal to the ground at Spithead, the Downs, Dungeness, Plymouth Sound, and the ports commonly used by men-of-war?—It is not equal in quality; but in either case the anchors will hold in smooth water.

1565. When you anchor in Dover Bay, is there not a particular mark for the best ground—do you allude to that ground in your evidence—do not you always anchor in the best ground?—There is a particular mark for the best ground, but I allude to the bay in general.

1566. Have you anchored in all parts within the proposed harbour, and tried the nature of the bottom?—Generally in a depth of from 5 to 7 fathoms, but not in every part of the bay.

1567. Do you consider that sailing-vessels are more liable to drive on indifferent ground than steam-vessels that are lightly masted, low and light in the water?—In a tideway they are the same; for that which acts against the ship, on account of masts and yards, is about made up by the resistance of the steamer's paddle-wheels.

1568. You say the "Blazer's" anchors are Porter's; have you used other anchors in her or other vessels in Dover Roads, and found the same effect with regard to the ground?—Porter's anchors only.

1569. In answer to Captain Fisher's question relative to getting out of the proposed har-

Mr. E. K. Calver.

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Mr. E. K. Calver.  
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bour off Dover, did you consider the difficulty of moving ill-manned and unwieldy merchant-vessels, who would feel a tide of four knots running across the opening between the piers, which of course they would have to contend with under any circumstances?—The difficulties they would meet with in going out by the south entrance they would avoid by using the eastern one.

1570. And how would they get to the westward if bound down Channel, the wind S.S.E. blowing a hard gale?—They would leave the harbour by the south entrance, while the flood was running; when out, there would be no difficulty.

1571. In light baffling winds what would be the consequences, the wind being as before?—If enough to give steerage-way, they would act the same.

1572. (*By the Chairman.*) In any difficulty, would not the tug-vessels be always at hand to assist?—I should consider them a necessary appendage.

1573. (*By Captain Fisher.*) In reference to Sir William Symonds' question, which referred to one put by me, supposing even that there is a tide running four knots, as you have stated the tide sets from west and by south to east and by north, would it not in that case rather assist a ship in getting out of the harbour, with the wind at S.S.E., instead of obstructing her?—Undoubtedly.

1574. (*By Admiral Dundas.*) Are you acquainted with Beachy Head and the shoals east of it?—I have a slight knowledge of them.

1575. If a breakwater was to be constructed, on which side of Beachy Head would you recommend that it should be placed?—On the west side.

1576. (*By the Chairman.*) For what reason do you give the preference to the west side?—I think the ground is more available, from its slope; a breakwater of any given length would afford greater protection, and a vessel would be kept away from the shoals eastward of Beachy Head. I speak of Newhaven because it is the head of the bight.

1577. Have you surveyed the bay on the east side of Beachy Head?—I have.

1578. When you surveyed it had you the position of any proposed breakwater marked on the chart?—Yes.

1579. And what was the distance of the proposed breakwater from the shore?—A little over a mile.

1580. What distance would such a breakwater be from the two fathoms low-water spring-tides?—Less than half a mile.

1581. What is the quality of the bottom between the breakwater proposed and the two-fathom depth?—Sand.

1582. Do you consider it good holding-ground?—I do consider it good.

1583. (*By Admiral Dundas.*) Suppose a breakwater on the east side of Beachy Head, with a light on the Head and another on the west end of the breakwater, would there be any danger in a ship running in during the night from the Sovereign Shoal, which lies five miles off?—In misty weather, certainly; but only then.

1584. (*By the Chairman.*) If a breakwater or harbour were to be constructed at the bottom of the bay at Seaford, do you consider that vessels in blowing weather would hesitate to run in?—No; for they would close the fair coast to the westward, free of dangers, and run along in a certain depth.

1585. And how far would that certain depth be from land?—A mile off shore, and the depth, 7 fathoms.

1586. Would not a vessel running in in such weather be going at too great a rate to get soundings?—She might get that depth without difficulty.

1587. If equally good anchorage could be found on the east side of Beachy Head, on which side would you rather have a harbour, if running in from a south-west gale?—To the west; because Beachy Head light is generally available, and I should avoid the dangers of the Holywell Bank and the Royal Sovereign Shoal.

1588. How far does the Holywell Bank lay off the shore?—I believe at an average of half a mile.

1589. Is there about the Royal Sovereign Shoal so little water as 7 feet?—Ten is the least I have heard of.

1590. Did you sound on the Sovereign Shoal when surveying there last month?—No.

1591. How far is the Sovereign Shoal from the proposed breakwater?—Three and a half miles.

1592. In rounding the Head in heavy hazy weather, it would be necessary to give a berth to the Holywell Bank which might carry vessels seeking shelter there (under a breakwater) towards the Sovereign Shoal?—It would entail two evils, either of closing the Sovereign Shoal or of missing the harbour of refuge.

1593. (*By Admiral Dundas.*) Supposing there was merely a small breakwater east of Beachy Head for steam men-of-war, would you consider that a better position for them than to the westward?—By no means, because the inner water at Newhaven gives superior advantage for a refit.

1594. Is not Newhaven a dry harbour?—It is; but as I propose using it for refit, and not for refuge, this would offer but little difficulty.

1595. (*By Captain Fisher.*) Would there not be more risk in a deep-laden merchant ship coming from the westward, and seeking shelter, running for a harbour of refuge to the westward of Beachy Head than to one constructed immediately to the east of it?—I think not; for by adhering to the plan before mentioned, she would never be led so far to leeward as to be unable to weather Beachy Head on the starboard tack.

1596. From a harbour constructed to the eastward of Beachy Head, would vessels bound



to the eastward find any difficulty, in westerly winds, in running out between the shore and the Royal Sovereign Shoal and other shoals?—No difficulty.

1597. (*By Mr. Walker.*) In stating your objections to a breakwater at the Brake, you stated that the soundings taken on the 15th were 3 to 4 feet less than you expected, would the objection apply with the same force if the soundings had been as deep as you expected?—Yes; for by interfering with the set of the tide through the small Downs, the scour would be lessened, and a disposition to sand-up be brought about.

1598. Is that your only objection?—It is my principal one.

1599. Would you be so good as to state what other objections you may have?—Because I think the same sum of money might be better devoted in constructing a harbour where none really exists.

1600. Does the objection to a harbour within the Brake being likely to sand-up, through an interference with the set of tide, apply to Dover?—No; because I have light sea-sand to contend with in the one case at the Brake, and not at Dover.

1601. Do you apprehend any silting up in any harbour, if constructed in Dover Bay, through the water held in suspension, during westerly gales or otherwise?—It would share with Ramsgate Harbour as to this particular, but in a less degree at Dover, as it would have a greater space to fall through before deposited.

1602. You stated that the greatest objection you had to a harbour at the Brake was its interference with the tidal current, would that objection apply with at least equal force to a harbour at Dover?—No; for I have different materials to contend with; the same interference would exist, but it would have less effect as to deposit.

1603. You stated that you would recommend the southern entrance at Dover to be placed, so as to be nearly at a tangent to a W.S.W. direction, will you, by looking at the plan, state whether that opening, No. 3 A, agrees with your view?—Not exactly, as the east pier head is not covered in sufficiently by the west pier head.

1604. How should that be remedied?—Either by carrying the west further out, or bringing the east further in.

1605. You gave us very particularly your views on the southern entrance, will you state your views upon the eastern, looking at the plans before you, and the entrance marked C, which lies east and west at a distance of about 600 yards from the shore?—It appears well arranged.

1606. Do you know Plymouth Breakwater?—I do.

1607. Do you think that as much above high water as the breakwater proposed at Dover would require to be?—Quite sufficient.

1608. (*By Sir W. Symonds.*) Will the fresh-water stream, and the silt and mud now deposited in Dover Harbour, have a good or bad effect on the large one when formed, as to deposit?—A bad effect; so much so, that I should consider it necessary to cut off the communication between the inner and outer harbour.

1609. With reference to one of your replies to Mr. Walker, would not the flood-tide be altered in its direction when rushing round the south-east corner of the harbour, thereby rendering the passage out by the eastern entrance to slow sailing unmanageable vessels dangerous?—I think not; the water would be perfectly still for two or three cables' length off.

1610. (*By the Chairman.*) Will that still water have a tendency to deposit?—I think not, because any deposit which would take place during the flood would be removed by an accelerated tide during the ebb.

1611. Do you consider that adding to or prolonging the south face of the breakwater that any eddy would be prevented, and a truer direction given to the tide?—It would, but I do not think the advantages gained would be equal to the cost of erection.

1612. Do you consider that an opening on the east from the shore, between high and low-water mark, would tend to give an increased effect to the current, and so prevent a tendency to deposit?—It would be slightly beneficial, but this would be out-balanced by the shingle which would be thrown in by easterly gales.

1613. (*By Sir H. Pelly.*) In answering the question respecting the effect of the tide across the entrances, have you taken into consideration the fact, that half the ebb or falling tide runs to the eastward and the other half to the westward?—I have considered it only as a tide running six hours one way and six hours another, without any reference to its rising and falling, as it is a harbour of refuge and not a tidal harbour.

1614. (*By Captain Washington.*) Is there not an eddy tide in shore, on the flood stream in Dover Bay?—Yes.

1615. Is there not a fear if an eastern entrance be left that the eddy on the flood stream will turn in at it, and meeting the main stream of tide flowing in at the central entrance, cause it to deposit the silt it holds in suspension?—None whatever, as the eddy on the flood would be done away with by the erection of the breakwater.

1616. From the effort the flood-tide coming up Channel will make to enter at the central entrance, will there not be an indraught into the proposed harbour that will materially assist a ship wishing to go in—and would not the same assistance be given to ships in leaving the harbour on an ebb-tide?—Certainly.

1617. What do you consider would be the proper width of entrance to admit of large frigates and East Indiamen entering at all times, and if necessary, to enable them to work in or out?—Three hundred yards at high water; speaking of large ships and working out.

1617. Will you state the advantages of a central entrance into an asylum harbour in Dover Bay over an entrance farther to the westward?—With a western entrance, after a

Mr. E. K. Calver.

17th May, 1844.



Mr. *E. K. Calver*. certain number of years, the shingle would block up the space to the westward of the western breakwater; it would then work out and fall round the end of the breakwater into the still water of the harbour of refuge; when there, there are no natural means afforded for getting rid of it.

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1618. (*By Sir H. Douglas.*) Would not the harbour be more likely to silt up if there were only one entrance?—Certainly.

1619. (*By the Chairman.*) Do you think that by a harrow or other means of disturbing the bottom, that it would be kept clean?—It would have but a slight effect, on account of the want of in-draught and out-draught.

1620. Do you not think that an active tide would be passing if there were two entrances, and an opening disconnecting the east pier and the shore?—The rate would probably be a quarter that of the stream tide.

1621. (*By Captain Washington.*) By leaving an eastern entrance, will you not isolate nearly half the breakwater, and cause difficulty in shipping supplies, in coaling steamers, and in landing passengers in an easterly gale?—All that traffic I would carry on on the western breakwater, which would have a communication with the terminus of the railway.

1622. Would there not be great difficulty in doing this in an easterly gale?—None.

1623. Is it a heavy swell and sea, or a strong wind that usually causes a ship to drive from her anchors?—By the sea under most circumstances, the swell having a tendency to trip the anchor.

1624. During the twenty or thirty times we may have anchored in Dover Bay, in the “Shearwater,” and “Blazer,” have we not always anchored within the limits of the proposed breakwaters?—Always to my knowledge.

1625. Has the ship ever driven from her anchor?—Never.

1626. (*By Lieut.-Col. Colquhoun.*) Will the accessibility of the proposed harbour be interfered with by the force of the discharge of water from it on the ebb?—Not at all, if there are two entrances.

1627. (*By Admiral Dundas.*) Would you not think it advisable to leave an eastern entrance open on the first formation of the harbour of refuge, and if found to disturb the ships in the harbour by the wind, sea, or tide, it would be very easy to fill it up?—It would, because the filling in is easier done than the making an opening, if found requisite.

[*The Witness withdrew.*]

Mr. *Werter Clark*.

Mr. *Werter Clark*, Pilot, re-examined.

1628. (*By the Chairman.*) Have you anything to add to your previous evidence respecting your opinion as to constructing a harbour at Dover?—I consider it a very eligible place on account of its situation, as being within a short distance of that point of land, the South Foreland, which all vessels coming from or bound to the River Thames must necessarily approach, and also being within a common tide sail of the Downs.

1629. Is Dover a good holding-ground?—Some good spots, but generally not good.

[*The Witness withdrew.*]

## EASTBOURNE.

Lieut. *John Conjuit*.

Lieut. *John Conjuit*, R.N., Coast Guard.

1630. (*Chairman.*) How long have you been at this place on the Coast-guard service?—12 years at this place.

1631. Have you, during your long residence, made a general acquaintance with the anchorage in front of the town?—Not particularly, only by repeated observation of the proceedings of vessels.

1632. During your time how many vessels have been seen wrecked?—Four.

1633. Under what circumstances?—Two from previously having been on the Beachy Head reefs, and two others springing a leak at sea, and running on shore purposely near the Circular Redoubt.

1634. What was the state of the weather?—In one case, thick blowing Channel weather; the other, in consequence of pilot's keeping too near Beachy Head, having under his charge an Italian vessel, and not making himself acquainted with her draught of water; he first struck upon reefs off Beachy, then drifted down upon Holywell Reef, when an English pilot and nine Italians perished.

1635. How was the wind?—In the first case from S.W., veering to W.S.W.; second case (*viz.*, Italian vessel), W. and W. by N. These cases have occurred since the erection of Belle Tout light-house, about 18 months since.



1636. Have you ever seen a square-rigged vessel riding at an anchor in Eastbourne Bay in heavy weather with the wind blowing into the bay?—No. Lieut. John Conduit.

1637. Have you ever seen vessels embayed here have a difficulty in working out?—I have never observed any. 17th May, 1844.

1638. Have you ever observed vessels strike on the Royal Sovereign Shoal?—Two.

1639. Under what circumstances?—Wind moderate, and fine weather.

1640. How was the wind?—In one instance W.S.W., the other instance nearly N.

1641. What became of the vessels?—They floated off upon rising of tide, and refused any assistance.

1642. What description of vessel?—Square-rigged barques, timber-laden, drawing probably 15 or 16 feet water.

1643. (*By Sir H. Douglas.*) Where would you propose placing a breakwater?—From Langney Point, embracing the Circular Redoubt.

1644. In what depth of water?—Six or seven fathoms water.

1645. What would be its extent?—About two miles in length, without the eastern and western arms.

1646. Being at that depth, how far off the land would that breakwater be?—I should say a mile and a-half, but have never ascertained the correct distance.

1647. Would such a harbour be much resorted to for shelter by the trade?—I am of opinion it would every winter season.

1648. Do you think a harbour of refuge on this east side of the Head would be more useful than one on the west?—I think it would.

1649. Why?—The prevailing gales are S.W., as I have noticed hundreds of vessels taken with a head wind upon their reaching Eastbourne Bay, and owing to heavy seas off the pitch of Beachy Head, unable to get round, and generally bearing up either for anchorage under Dungeness or the Downs.

1650. (*Admiral Dundas.*) What number of vessels have you ever seen take shelter in the bay in W.S.W. gales at one time?—Not more than a hundred.

1651. Have you ever seen a steamer lying there?—Several large steamers.

1652. Did you ever see a ship caught in this east bay with the wind blowing hard in and she held on at her anchors?—I have not.

1653. Does the wind fly round from W.S.W. generally to N.W.?—It generally does in winter months.

1654. Does it fly back to south?—Very rarely.

1655. (*Captain Fisher.*) Could vessels outward bound seeking refuge at this anchorage lie round Beachy Head and the Boulder or Holywell bank or shoals with the wind southerly, which would take them down Channel?—Yes, with the distance of about two miles from the shore, giving a weather-start from their anchorage.

1656. Could vessels bound to the eastward go out with facility from this anchorage between the Sovereign Shoal and the shore in all winds that would be fair round Dungeness?—Yes.

1657. Do you apprehend or know of any difficulty that vessels would experience in reaching this harbour from the westward at any time of tide and very bad weather?—I do not apprehend or know of any danger or difficulty.

1658. What is the set of the tide close in with the Head and along the shore to Langley Point?—Flood tide sets off from Beachy to S.E. (offing strong), with no great indraught to Eastbourne Bay.

1659. What holding-ground generally is in the space of the proposed harbour?—Stiff mud and sand.

1660. (*Sir Wm. Symonds.*) Are you sure it is clear ground where you would place the breakwater?—I have every reason to believe so, having swept over it with sweeping-lines and creeping-irons.

1661. Do trawlers ever use it?—At all times.

1662. What is the effect of S.E. gales,—do you remember to have observed a heavy ground-swell when it blows so?—Heavier swell from that wind than any other point, lasting only during the gale, which is of rare occurrence.

1663. (*Captain Washington.*) What is the greatest number of vessels you have seen anchored in Eastbourne Bay under any circumstances at one time?—In N.W. gales from 50 to 60.

1664. Any of large burthen, and what?—From 500 to 600 tons, (in one instance a French naval store brig of burthen); others, laden colliers and coasters.

1665. What is the movement of the shingle on this side Beachy Head?—Varies much; at times leaving a level sandy strand; the south-west winds carries an accumulation of shingle to Langney Point.

1666. Do the north-east or south-east gales bring it back?—The north-east partially; south-east not.

1667. (*Chairman.*) Does the Holywell Shoal appear to give much shelter during south-west gales?—It does, preventing heavy seas immediately opposite the Sea houses, and sheltering the bight of the bay to Langley Point.

1668. (*Lieut.-Col. Alderson.*) Does the sea encroach here?—It does annually to the westward, where there are no groynes.

1669. Is not that beach retained by groynes?—It is by several to the eastward.

[*The Witness withdrew.*]



William Simpson.

William Simpson, Fisherman.

17th May, 1844.

1670. (*Chairman.*)—Are you a pilot?—No.  
 1671. Do you ever trawl?—Yes.  
 1672. How far off?—Between this and the Sovereign Shoal.  
 1673. Have you trawled all the way between this and the Sovereign Shoal?—Not above a mile from the shore.  
 1674. Why not farther?—Because there is no trawling-ground; it is all hard ground.  
 1675. What sort of bottom do you find there where you do trawl?—A good bottom and sand; good holding-ground; but to the south-west of the beach houses the ground is not good for holding; but in front and to the eastward the ground is good.  
 1676. How far off from this shore do you get two fathoms at low-water spring-tides?—Rather less than a mile.  
 1677. And how far seven fathoms?—About a mile and a half.  
 1678. Have you ever known a vessel get on shore on the Royal Sovereign Shoal?—Yes, two.  
 1679. What were they?—Two timber ships.  
 1680. What became of them?—They both got off again, there was about 12 feet water where they were lying, over the rocks.  
 1681. Have you ever been much on the west side of the Head?—Yes, about Seaford and Newhaven, driving for mackarel.  
 1682. Have you ever trawled there?—No.  
 1683. What bottom is it?—Smooth sandy bottom in Seaford bay.  
 1684. Have you ever seen ships bring up in Seaford Bay?—Yes, when blowing from the eastward.  
 1685. Have you ever seen ships riding when the wind was blowing in?—No.  
 1686. Have you ever seen ships riding in the Eastbourne Bay during a gale from the eastward?—No.  
 1687. How many have you seen in this bay at a time?—50 or 60 in westerly winds.  
 1688. (*Admiral Dundas.*) Is there any buoy on the Sovereign Shoal?—None.  
 1689. Did you ever see a large steamer lie in Eastbourne Bay?—Irish and other steamers in winter.  
 1690. Do ships in general avoid this bay and bear up for Dungeness?—They do; strangers especially.  
 1691. Is that from fear of the Sovereign Shoal?—Rather from not knowing that there is good holding-ground.  
 1692. Did you ever know the wind fly back round to the southward, or does it generally fly round to the Northward?—Generally to the northward.  
 1693. Do you think a breakwater protecting the bay from the eastward would be of any service here?—Yes.  
 1694. (*Mr. Walker.*) For what purposes?—For all crafts.  
 1695. (*Sir Wm. Symonds.*) Do you know the Horse of Willingdon?—Yes.  
 1696. How far from the Royal Sovereign?—Two miles south-east nearly.  
 1697. What water on the Horse?—It varies, and never less than four or five fathoms at low-water spring-tides to my knowledge.  
 1698. Are there not some other shoals not far distant from the above mentioned?—Several; all shoal water.  
 1699. Of what extent do you think that cluster of shoals is?—From the inner edge to out, or from north-west to south-east, about five or six miles; and from south-west to north-east, about half that.  
 1700. (*Capt. Washington.*) Did you ever see or hear of any privateers in Eastbourne Bay?—Several.  
 1701. (*Mr. Walker.*) Is there a good deal of shingle on your beach; is it always there?—Yes.  
 1702. Have you never seen the beach between this and Langney Point clear of shingle?—I have, but very rarely.  
 1703. In trawling, do you find any shingle?—No, but we find large flint chalk stones sometimes towards Pevensey Bay, but the shingle is only found between high and low water.

[*The Witness withdrew.*]

William Head.

William Head, Fisherman, aged 37 years.

1704. (*Chairman.*) Have you resided here all your life?—Yes, as a fisherman.  
 1705. What sort of ground is it off here?—Sand for about three miles, then rocky.  
 1706. Is there much rock in the bay?—Not till three miles off shore, and then a good deal; large rocks on the Horse of Willingdon.  
 1707. (*Mr. Walker.*) In trawling, do you ever find shingle below low-water mark?—No.



1708. (*Admiral Dundas.*) Do you find vessels anchor here in south-west gales?—Yes.

*William Head.*

1709. Did you ever know ships ride out an easterly gale in Eastbourne Bay?—No.

1710. (*Mr. Walker.*) How is the bottom of this bay as compared to Seaford Bay?—The ground here within the shoals is about the same.

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1711. Have you seen many ships take refuge in Seaford Bay during an easterly gale?—Many.

[*The Witness withdrew.*]

Lieut. *Robert Mann*, examined.

Lieut.  
*Robert Mann.*

1712. (*By the Chairman.*) How long have you been on this coast?—Thirteen years at the Hastings station.

1713. Are you at all acquainted with this part?—No, only the locality of Hastings.

1714. Did you ever command a Revenue Cruizer?—No; never.

1715. You cannot therefore give us any information respecting this situation?—No; Hastings is 18 miles from this, and my duty confines me to that place, about which I am well acquainted, and have sent reports respecting it to the former Committee on Harbours.

[*The Witness withdrew.*]

*Richard Harman*, Ship-owner.

*Richard Harman.*

1716. (*By the Chairman.*) Have you any knowledge of the anchorage in Eastbourne Bay?—Yes, it is a sandy bottom; not a very good holding-ground.

1717. How far out is the good holding-ground?—From 3 to 3½ miles.

1718. Did you ever cut or chafe your cable?—No, never.

1719. Have you ever known a ship to ride in Eastbourne Bay in heavy weather?—No.

1720. What is the greatest number of vessels you have ever seen at one time at anchor in Eastbourne Bay?—About 20 sail.

1721. Do you consider the Boulder Bank or Holywell in the way of the navigation?—I do; it is dangerous in hauling round the Head

1722. How many vessels have you known strike?—I have, witnessed four or five, and I have heard of more.

1723. Have you ever anchored above the Sovereign Shoal?—I have not.

1724. Have you been much accustomed to Beachy Head?—I have, in the coasting trade.

1725. Suppose a harbour constructed on either side of Beachy Head, which do you suppose would be the best?—The eastern side.

1726. Why do you consider the eastern side?—The prevailing winds being for 9 months south and westerly winds.

1727. Should you not consider the Boulder Bank which you describe as so dangerous, and the Royal Sovereign Shoal an objection to drawing vessels to an anchorage in this Bay?—I think so.

1728. Do you know Seaford Bay?—I do.

1729. How often have you been riding in Seaford Bay?—A hundred times.

1730. What places have you been trading to?—Coasting generally.

1731. What is the nature of the bottom in Seaford Bay?—Good holding-ground.

1732. Did you ever ride there with a gale on the shore?—Never did.

1733. (*By Admiral Dundas.*) Does the wind fly suddenly round from the westward to the south, or generally to the northward?—Yes, to the north; after blowing strong it generally flies in to the northward, with heavy showers.

1734. In the War, after heavy westerly gales, when our cruizers have not been able to recover their station; have you ever heard or known of French privateers capturing our merchant-vessels in this neighbourhood?—I have witnessed it three or four times.

1735. Do you think, now, the government steamers could with perfect safety keep the sea for the protection of the trade, by moving round Beachy Head as the wind changed from westward to eastward, in all weathers?—No; there can be no protection in either bay, when it blows hard from south-west.

1736. In which bay could you put a breakwater to protect the cruizers from south-west gales, so that they may be always kept on their station?—A breakwater might be put from Langley Point, in a south-east direction, to protect Pevensey Bay.

1737. Would you run that breakwater from the shore or not?—From the shore, there being good water at the point; I would make it in the form of a half moon.

1738. What water is there?—From five fathoms to seven fathoms.

1739. What distance off the land would you find seven fathoms water south-east from Langley Point?—About two miles and a half.



Richard Harman.  
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1740. Have you ever had a plan?—No.

1741. Could a harbour be constructed to protect Pevensey Bay, accessible at all times of tide, wind, and weather; day and night?—I should doubt it.

1742. Do you think that steamers could keep their stations when it blows hard from the southward and westward?—Certainly not.

1743. (*By Captain Fisher.*) Have you long commanded a vessel in the coasting trade, and have you frequently anchored in this bay?—Frequently.

1744. Could large ships, bound to the eastward, go out of this bay, between the Horse of Willingdon, the Sovereign Shoal, and the shore, with a wind that would take them round Dungeness?—Yes.

1745. And could vessels bound to the westward also, from their anchorage, round Beachy Head, and the Boulder Bank, with the wind not to the eastward of S.S.E., or to the westward of south?—With the wind at S.S.E., they would clear the Head and the Boulder Bank.

1746. Do you know of any difficulty that vessels would experience in entering the harbour from the westward at any time of tide and in heavy weather?—Not if proper lights and guides were erected.

1747. What sort of holding-ground generally will be found within the space of the proposed harbour at Langley Point?—Very good.

1748. (*By Sir J. Pelly.*) Is there any place, in your opinion, in which a harbour could be constructed between Newhaven and Dungeness?—None.

1749. (*By Captain Washington.*) From your knowledge in the coasting trade, what do you consider the most eligible place for a harbour of refuge between the Thames and Portland?—Dungeness.

1750. (*By the Chairman.*) How far out do you think the shingle at Dungeness has extended in your time?—About 100 yards.

1751. (*By Mr. Walker.*) Have you any other objection to Dover as a harbour of refuge except on account of the accumulation of shingle?—No.

1752. (*By the Chairman.*) What do you consider the general character of the bay eastward of Beachy Head?—Generally shoal water from Beachy Head to Fairlight.

[*The Witness withdrew.*]

William Breach.

William Breach, 40 years a Fisherman.

1753. (*By the Chairman.*) What is the nature of the ground between this and the Sovereign Shoal?—Sandy soil till you come to rocks.

1754. And how far is that?—About 5 miles.

1755. How old are you?—70 years.

1756. Do you recollect any ships being lost here?—Several.

1757. What?—The “Thames,” a West Indiaman, and many wrecks in various places; twenty of different nations.

1758. Have you ever seen a ship riding out a gale off here when blowing on shore?—Never, but many off Hastings; it is very good ground off Hastings.

1759. How many ships have you known lost off Holywell Bank?—Several; many were lost before the light-house was erected; I imagine they mistook Beachy Head for South Foreland, at that time; and hauling round, they struck on the Boulder Bank.

1760. (*By Admiral Dundas.*) How often have you seen French privateers in shore during the War in this Bay?—Many times, and have seen them take away a great number of vessels; I have been employed in the sea fencibles in retaking them; and once went off and took a privateer.

1761. Was not that owing to our ships being unable to keep their stations from the severe westerly gales?—It was so.

1762. You see now what steam can do; could not a strong squadron of steamers keep the stations and prevent even French steam privateers from annoying the coast as sailing privateers used formerly?—Certainly, better than sailing vessels; but I consider, in strong S.W. gales, steamers could not keep their stations or any other men-of-war.

[*The Witness withdrew.*]



## NEWHAVEN.

*Saturday, May 18th, 1844.*

Admiral Sir T. BYAM MARTIN, in the Chair.

*William Stevens, examined.*

*William Stevens.*

18th May, 1844.

1763. (*By the Chairman.*) What is your situation here?—Harbour master.

1764. How many years have you been in that situation?—About 15.

1765. And what situation of life were you in before you came here?—I think for about a dozen years before I did nothing. I had left off the sea; but for 27 years before, I was always at sea.

1766. Did you ever command a coasting-vessel?—Yes.

1767. During war?—Perhaps half a dozen different vessels, from the East Sea to Dublin, for perhaps 27 years, and coasting-traders.

1768. What was the state of the harbour when you first came here, and how many years ago is it?—Fifteen.

1769. And what have been the improvements? describe the state of the harbour when you first came?—When I first came there was what we call a dickey-work, a low jetty-work. It ran out of the east pier parallel with the west pier, about 4 feet above low-water mark, and was intended to lead the water straight into the sea, but failed to do so. Then I think there were four acres of dry beach before the harbour at low water, when the wind was from the south-west, partly on one side and partly on the other. The water had left it. Then, about nine years ago the east pier was extended to put the water straight; this dickey-work did not do the work well. Then the east pier, about nine years ago, was lengthened, and carried out parallel with the west pier, right over the dickey or jetty-work that was built into it. That set the tide so powerfully upon the beach, that it cleared it away in the first two years. Since that time we have not had half an acre of loose beach crossing the harbour at low water at one time.

1770. What work are you now about for the improvement of the harbour?—Carrying out the groyne to the west of the harbour for a length of 500 feet from high-water mark.

1771. What depth will the end of the groyne or pier have at low-water spring-tides; and if it should be carried out 500 feet further, what depth of water will it take you into?—About six feet of water at low spring-tides.

1772. Going out in a direction seaward over the Fricker Rocks, at a depth of six fathoms, what is the quality of the bottom?—I should think it may be a great part of it chalk rock. Rather low, soft chalk; other parts, clay.

1773. A hard bottom?—Rather hard; chalk rock.

1774. When I speak of a bottom, I speak of anchor-ground?—It is not too hard, I think, for an anchoring-ground.

1775. Not sand upon it?—No, neither do I think the ground is so hard but what an anchor might hold. I never saw one come home there.

1776. Have you ever seen any vessel riding there in blowing weather?—Riding very heavy gales at times.

1777. A good deal of sea coming in?—Yes.

1778. Are you speaking of frequently seeing vessels lying there in a blowing wind, with the wind on shore?—They do not choose it; but when they are caught, I have seen it many times.

1779. And under such circumstances, do you know of any instance of their parting or driving?—No.

1780. Then what you are stating would seem to show that it is good holding-ground?—Yes, it must be good, but not so good as the bay.

1781. The sea you are describing made the vessels pitch?—Very much.

1782. Where do you consider the good holding-ground to commence, going towards Seaford?—I should think, from this breakwater, the whole bay altogether good to the eastward.

1783. You are speaking now of going out considerably over the Fricker Rocks, do you mean to say that all this anchorage in front of the harbour, within the line we are speaking of, to the south-east, is good holding-ground?—I never knew to the contrary.

1784. Do you consider the ground, to the front of the harbour seaward, to be as good as it is down more towards Seaford?—Yes, I never saw anything to the contrary; I never saw an anchor come home there in my life.

1785. Have you ever sounded it yourself?—Yes; but it is a good many years ago. I suppose there is no alteration.

1786. At what expense is the estimate the work will be that is now in progress?—I think it may be about 1500*l*.

1787. And if carried out to a thousand feet, what do you suppose it would be?—Why, there it would come heavy; there you would more than double the expense. I think perhaps 4000*l*. additional.

1788. Look at this chart; suppose it should ever be decided to have a harbour con-



William Stevens.  
 18th May, 1844.

structed, or a breakwater, where do you think it would be best placed?—I should think in the direction of the Fricker Rocks will be best.

1789. But that would be no protection from the south and easterly winds?—Not the least.

1790. What would you propose for that?—No better than what is laid down here, running to the south-east.

1791. Now in point of fact, would it not be a better thing, and enclosing what is generally considered better ground, to carry it more to the south-east, in front of Seaford?—No, I should think not any better; I should say this is the best plan.

1792. And why do you say this is the best plan?—Because it is in every way formed the best; and if you needed any southerly protection, run it off from Seaford Cliff.

1793. If the anchorage here in front of the harbour is as good as it is to the south-east, fronting Seaford, why is it that the 22 vessels now lying at anchor are all down in the Seaford Roads?—I think if they were all here they would say it would be as well to ride at this port off the harbour, only it is convenient for them to get ashore there to get provisions.

1794. Would it not be more convenient for them to go on shore at this town to get provisions than down at Seaford?—There is a drift of two miles between that and the pier where they lie, and that makes a bubble of a sea. A little ship that has got only two hands to send on shore here could not do it so easily as they can up there, lying close to Seaford.

1795. Are you aware of any rocky ground at Seaford?—I think there is a little a short distance off, but I am not well aware of it; I think, nothing to damage the anchor-ground.

1796. Do you know of any borings made in front of your harbour to ascertain what is under the sand?—I do not know.

1797. Do you know of Captain Bullock having made any borings?—I heard him say he had.

1798. What is the breadth of the entrance between the piers?—110 feet or thereabouts.

1799. Is that found, practically, to be inconvenient or too narrow for the navigation?—No, not for our own trade.

1800. At what time of tide do vessels generally pass into the harbour?—Colliers of 12 feet water pass in, I should think, an hour and a half before high water.

1801. Do vessels go out at all times of the ebb whilst there is water for them?—Not always; they do not consider it safe; they prefer high water.

1802. They do not go out in a falling tide?—They do not like to do it.

1803. What is the inconvenience?—Because if they get a-ground, they lie ugly upon the river.

1804. Is there anything that you can suggest for the improvement of the interior of the harbour?—Yes, it might be widened.

1805. Do you mean widened at the entrance?—Yes, and deepened.

1806. Describe in what way, and to what extent you would widen it?—Upon the east pier from 40 to 50 feet, so as to make the entrance 150 feet wide.

1807. And having done that, would you continue the passage up the harbour at the same breadth?—Within the pier head I would make the harbour wider.

1808. If you were to make the harbour wider within, would there be no fear of its diminishing the strength of the back-water?—I should think, not much. In widening the pier, I would propose to extend both piers not less than 200 feet further into the sea.

1809. Would you propose the east and the west piers running out to an equal distance?—Exactly so.

1810. What water would you carry your pier head into?—A foot and a half more than it is now.

1811. What do you hope to gain by carrying it out to that distance, when you have only a foot and a half more water by it?—Why, I think it would put the ebb-tide straight into the sea, and the materials might be dredged to almost any reasonable depth.

1812. That being your object, would it not be better to extend the pier still further out?—I think 200 feet would be sufficient; not less than that.

1813. If it were carried further of course it would accomplish your object the better?—Yes, 400 feet would be better.

1814. Now supposing that done, and, instead of widening the harbour as you are proposing, a wall should be carried along the present line of the harbour there, turning this marsh-land on the east side of the harbour into a wet-dock, supposing that to be accomplished, should you consider it a great convenience and accommodation to the trade?—I do not think it would to the trade; the trade has got plenty of stowage nearer the town, and which might be easily improved.

1815. You mean to the trade of the port it would not be a great accommodation, but to vessels coming in for shelter it would?—Yes.

1816. Is there any particular action of any tide on the east pier?—No, not any.

1817. I think Mr. Whitby, when he was down, made some observations about that?—There was then, because one pier was longer than the other. The tide then did not enter the harbour straight, and now it does.

1818. If your piers were to be conducted to the extent you propose, would the natural back-water be sufficient, or would you have any additional sluicing power to force the shingle away?—I should think the natural back-water would be sufficient.

1819. And that it would not be desirable to make Sleeper's Hole a back-water?—I should think not.

1820. Now if your piers were extended to the distance proposed, or to 400 feet, how



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much beyond that do you suppose the effect of the tide could be felt, so as to clear the ground?—Perhaps 1000 feet beyond that.

1821. Then at the end of that 1000 feet it would settle down?—I do not calculate we should have much loose material when we had got a breakwater to the westward.

1822. Then at the end of the 1000 feet, where the back-water loses its effect, there the mud would settle down and form a bar?—I think not; the current out of the harbour would extend 1000 feet from the pier-heads, and further when the land-floods came down powerfully.

1823. If an artificial harbour were constructed surrounding the present entrance, where would you propose to have the entrance to it?—For my own part I would not have an entrance from the westward at all, but one entrance only from the eastward. Since I have had time to think of the good or evil a 600-feet opening may do on the W.S.W. side of the breakwater, I beg leave to submit for your consideration, in very strong westerly gales, would not the sea come in powerfully and damage the best part of the anchoring-ground; and in fine weather, would not the strong flood-tide run in and cause a counter-tide; if so, it would disturb the well lying of the ships. I think this would apply to any other foul-weather erection put up between this and Dover.

1824. Then if there was only one entrance, would not the tide tend to fill this up?—I think it might.

1825. Have you any dredging-vessel belonging to the port?—No; we have some barges for dredging, worked by hand.

1826. What are the charges upon ships entering this port—the harbour dues?—Two-pence a-ton upon the register.

1827. Do you know what is about the average of the annual produce?—About 2500*l.* a-year.

1828. Are there not some harbour dues—some income derived above the bridge?—That is for what is called the Lower Navigation, between here and Lewes; it is a distinct part, to keep up their banks.

1829. Do you know what is the amount of it?—No.

1830. Is there any part of that money taken above the bridge applicable to the improvement of the lower part of the harbour?—No.

1831. How many commissioners are there?—Quite 50, I think.

1832. Do you know if the Act of Parliament makes it compulsory on them to have a reserved fund?—No, I am not in possession of that.

1833. What number of vessels have you known at any one time in the harbour?—I have seen 30 sail at a time.

1834. After your long experience here, what are the greatest improvements of which you think the harbour is susceptible; and what could be done to improve the interior of the harbour?—Nothing could be done to improve the interior of the harbour further than dredging the bottom and removing the banks.

1835. (*By Sir Howard Douglas.*) You said that the roadstead opposite the harbour is not so good as in Seaford bay?—It may be rather better clay there in spots than off Newhaven.

1836. You think that the enlargement of the inner harbour to the eastward would not be required by the trade of the town?—Not by our present trade.

1837. But would not the enclosing of Sleepers' Hole be convenient to the trade?—We have no trade here that lies in the docks; they want dispatch.

1838. Then you think the great object of any improvement contemplated here would be for shelter?—More for shelter for the whole Channel shipping in bad weather.

1839. And that would depend upon the harbour of refuge and the safety of the roadstead?—Yes.

1840. And upon its capacity?—Yes.

1841. Have you thought of the length of breakwater, and its position in depth of water, that would be requisite to make a roadstead of sufficient capacity to be really generally serviceable to the country as a harbour of refuge?—Yes.

1842. What length of breakwater?—I should think a mile and a quarter. My notion was to extend the pier or breakwater from Fricker Rocks in a southerly direction out into deep water, curving eastward at the south end in not less than 7 or 8 fathoms; and I do not think of any other pier being required in an east and west direction.

1843. Looking at the plan before you, and carrying out your breakwater in one line to 6 fathoms, would you, in addition to that, propose the breakwater to be extended, and in what direction?—I should fall into this direction, curving towards Seaford Head.

1844. Do you think there should be an opening between the pier of which you speak and the south pier or the east and west pier?—That would improve it very much.

1845. (*By Admiral Dundas.*) Between what points of the compass does the wind bring in the heaviest sea?—From the west, and between the west and W.S.W.

1846. What is the common rise and fall of the spring-tides?—Some spring-tides 18, and some 21 feet.

1847. What is the rate of the spring-flood, or ebb?—I am not acquainted with it; I should think about four knots, to the best of my knowledge; but I hardly know.

1848. Would any alteration or improvement which you have suggested now or heard from others, ever make Newhaven Harbour accessible, even at half tide, for merchant-vessels?—Yes, with this exception, there is such a strong flood runs in, that vessels do not like to take the piers without a great deal of steerage-way and a strong wind.



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1849. With the prevailing west winds, why do you recommend Seaford, which is on the weather side of Beachy Head, for a breakwater, instead of Eastbourne Bay, which is to the eastward and to leeward?—Eastbourne Bay would be better than this bay, with the wind strong from the west; but with the wind from the east there is no protection at all.

1850. But if you had got a breakwater to the east, would that be a better protection for vessels than a breakwater to the west here?—I do not think it would be always so good; we have got a better eastern side; they have got no eastern protection.

1851. Do you remember, during war, English cruizers being often driven from the station at Beachy Head by heavy western gales?—Yes.

1852. Are you acquainted with the power of steam-vessels?—No.

1853. Do you think a powerful steamer could keep the station off Beachy Head by anchoring in heavy gales from the eastward in Seaford Bay, and in western gales in Eastbourne Bay?—She would require more shelter if the wind came from the south; she must get under way.

1854. Then taking all that into consideration, the protection of the coast and the protection of the trade, on which side of Beachy Head would you recommend a breakwater to be made, throwing overboard Newhaven?—Why this, I think, under present circumstances, would be the best. We only want one side to our bay, and they want two sides.

1855. (*By Captain Fisher.*) Could ships sail from this harbour bound to the eastward or to the westward as they might require, with all winds that would enable them to proceed on their voyage?—I think they could if this breakwater were carried out.

1856. Would vessels from the harbour in question reach round Seaford and Beachy Head with a wind that would take them from thence to the South Foreland?—Yes, unless in extreme weather, when it blew a gale from the south.

1857. Do you see any difficulty to vessels seeking shelter in this harbour in heavy gales from the westward?—Not any.

1858. What would be the consequence to a vessel so seeking shelter in a strong south-wester, if she should fail to get the harbour?—I cannot think she could fail if the breakwater were carried out.

1859. What is the general feature and quality of the ground within the limits of the proposed breakwater, and do you think it is better than Seaford Roads?—I do not think it is better; but I do not think it is worse.

1860. What would be the general set of the tide through this bay to Beachy Head if the breakwater were built?—It would change the set of the tide a good deal; but I should say nothing disastrous, or likely to do an injury. It would make less tide, I think.

1861. (*By Sir W. Symonds.*) Have you tried the depth and the nature of the bottom yourself, or do you give your evidence from supposition, or from the evidence of others with regard to the ground within the proposed breakwater?—I think I must have rode hundreds of times in all gales of winds in the bay, and I never found bad holding-ground.

1862. Have you sounded all over it?—No, I never sounded; but I have anchored in it hundreds of times.

1863. (*By Sir Byam Martin.*) Let me ask you at what period did you correspond with Mr. Alexander, the architect, on the subject of improving the harbour?—I should think about 30 years ago.

1864. Was it Mr. Alexander's opinion that there ought to be a breakwater?—He always thought it a place for improvement.

1865. Was it his opinion that there ought to be a breakwater?—No, he never proposed a breakwater at all. I endeavoured to draw his attention to it, by a pencil sketch; but at about that time the privateers all gave up.

[*The Witness withdrew.*]

Captain  
 Sir Henry Shiffner  
 Bart., R.N.

Captain Sir Henry Shiffner, Bart., R.N., examined.

1866. Are you one of the Harbour Commissioners?—I am.

1867. How long have you been so?—For a number of years.

1868. Fifteen or twenty?—At least, but I have had very little opportunity of attending the meetings until lately.

1869. Have you given much consideration to the interior of the harbour of Newhaven?—I have.

1870. Can you suggest any particular improvement in the interior?—I can suggest nothing beyond what is in that paper which I drew out and sent to the Admiralty, and to you, Sir.

1871. It is here, perhaps you will read it,—(*The paper was then read.*)—See Appendix.

1872. Is the groyne-work you are at present about intended to be carried out 500 feet?—It is almost that distance now; it will be 500 feet when completed; it wants but 15 or 20 feet to complete it.



1873. Why do the Commissioners stop short at 500 feet?—That was the distance suggested by Mr. Walker; it was the most economical plan suggested of the three proposed by him. I produce Mr. Walker's report.

1874. Do you not think it would be a considerable improvement to extend it 1,000 feet?—I think it would; but in that case it should have been further from the west pier; that its outer end should not bear much to the south of its present bearing, or it might interfere with ships leaving the port with easterly winds.

1875. Do you think the Harbour Commissioners would have any objection on account of the expense?—I do not think the Harbour Commissioners at present would sanction it from their funds, because there were three meetings held before they would sanction even the present work; there was great opposition, and the present groyne was only carried by a majority of two.

1876. What ground of opposition could there be to it?—They very much doubted its being of any advantage.

1877. But is it not generally understood that extending piers or groynes into the sea must be for a time a protection to the mouth of the harbour?—For a time certainly, but the opinion was that after a certain time so large a collection of beach would take place that it might fall over the groyne and become injurious to the harbour by blocking up its entrance.

1878. Have you any knowledge of the quality of the bottom in front of the harbour?—I have never sounded in front of it.

1879. Do you believe that the anchorage between the Fricker Rocks westward and fronting the harbour is as good as it is towards Seaford?—Certainly not, it is broken ground.

1880. If you were called upon to fix the position of a breakwater in this neighbourhood, where would you place it?—I should place it to the eastward of the harbour's mouth.

1881. How far to the eastward?—In point of distance I should have difficulty in stating. I should say to enclose the best anchorage off Seaford, and in about eight or nine fathoms water.

1882. If you were to place a breakwater where you describe, would you have a breakwater also running in a direction from Barrow Head, seaward?—Yes.

1883. Why do you prefer placing it in the situation you have mentioned, is it the better quality of the bottom?—Because of the better quality of the anchorage within it, the ground is a stiff, blue clay.

1884. Now I would ask you, as a seaman, and forgetting for a moment that you are a Commissioner of Newhaven Harbour, at what position between the North Foreland and Portland would you propose as best for a squadron of men-of-war, and particularly men-of-war steamers, to watch the opposite coast, to give protection to the entire trade of the Channel, and as a harbour accessible at all times of tide, and day and night, to the trade of the country?—If I were to pass eastward from St. Helen's, I should unquestionably fix upon Seaford Roads.

1885. By saying if you pass to the eastward of St. Helen's, was that in reference to Portland?—In dividing the distance.

1886. What place between the North Foreland and Portland?—I should prefer Portland to any, because of the narrow part of the Channel and the advantage it would give for watching vessels leaving Cherbourg.

1887. Then, coming eastward, which place do you think the best?—Seaford.

1888. Suppose you were running in a heavy south-west gale and hazy weather, which would you feel, as the captain of a ship, was the most satisfactory, to pass round Beachy Head to find shelter on the other side or to find a breakwater at Seaford Bay?—That would very much depend upon the character of the breakwater; if it were such a breakwater as I should feel confidence in, I should prefer Seaford Bay.

1889. Suppose the marsh-land to the eastward of the harbour converted into a basin, should you think that a great benefit to the trade of the country?—Very great indeed.

1890. Would you prefer that to the smaller accommodation in Sleepers' Hole?—I should, but if Sleepers' Hole would afford a sufficient space, you are more under shelter in Sleepers' Hole, and that would give it an advantage. Sleepers' Hole would afford space for a basin of five acres, and there would be sufficient room at each end for dry docks.

1891. Looking to the possibility of its being required for the accommodation of a large steam squadron?—I should then prefer it to the eastward, there being much greater accommodation.

1892. Should you consider in that case it would be desirable to turn Sleepers' Hole into a harbour for sluicing, supposing you had a basin on the other side?—It would be of service certainly; it would be worth clearing out for that purpose.

1893. Is it your opinion, as one of the Commissioners, that it would be advantageous to lengthen out the piers seaward?—Decidedly so, I have always been of that opinion, and have frequently advanced it at meetings of the Commissioners.

1894. Is that the prevailing opinion among the Commissioners?—I do not think it is, I believe there are many who would oppose it.

1895. But if it should be recommended by the Government, do you believe that the Commissioners would give way and consent to what they should recommend?—I have no doubt of it.

Captain  
Sir Henry Shiffner,  
Bart., R.N.

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1896. And do it at their own expense?—I think they would go to a certain expense; I think it is probable that they might be induced to do it to the extent suggested by Mr. Walker, if recommended by the Government.

1897. And to what distance?—130 feet in addition to the present piers. The extension of the west pier 130 feet in length to be solid to the level of high water, and the east pier to be solid to the level of half-flood and open above, the extension of the two piers being parallel, but each side set back 10 feet from the present line so as to add 20 feet to the present width of the entrance, which, on entering, would be a great improvement.

1898. Can you tell to what depth of water the pier at 130 feet would bring it?—I cannot; I should think not a very great depth. My reason for leaving the upper part of the east pier open, as suggested by Mr. Walker, is, that when the sea from the south-west passed round the western pier it would pass through the open work of the eastern pier and expend itself to the eastward, instead of rebounding, which it does at present, and makes the navigation very difficult. It would have another advantage, which I hardly think Mr. Walker had in view when he contemplated it: the last half-flood sets to the westward at the harbour's mouth, and the open work would allow the tide to pass through, and, meeting the western pier, the tide would run freer into the harbour. It would throw a greater quantity of water into the harbour by passing through the open work and meeting the western pier; it would run truer into the harbour and prevent the tide being forced round as it is now. If you see it now, it strikes upon the eastern pier.

1899. Do you consider it desirable that there should be a greater rush of tide than there is?—I think it would be an advantage to increase the flow of water into the harbour.

1900. I thought it was an objection that there was such a rapid tide?—I do not think the flood-tide is of that force that there could be any inconvenience.

1901. Do you think it would be an improvement on Mr. Walker's plan to carry it out further?—I think so, certainly into 12 feet at low-water spring-tides.

1902. (*By Mr Walker.*) Excuse me interrupting you, but in reporting that, I had it in view that I was reporting to Commissioners with limited means.

1903. (*By Sir Byam Martin.*) I was going to ask the question whether the funds had not an influence on the report; but as you said before, if Government were to recommend the carrying it out further, you have no doubt the Commissioners would accede to it?—I cannot speak confidently upon that; I think they might.

1904. How many Commissioners are there?—60 or 70 at least.

1905. And what number are the effective, the managing Commissioners?—I should call 30 a large meeting. I think I have seen 30 upon the question of the present point.

1906. Is it not likely to be inconvenient having so great a number of Commissioners?—Certainly.

1907. Has party-feeling anything to do with these things?—I never knew meetings held at Lewes without party creeping in sooner or later.

1908. Are many of the Commissioners, the managing Commissioners, proprietors along the banks of the river?—Yes.

1909. (*By Sir Howard Douglas.*) Can you point out the position and extent of a break-water enclosing that part of the roadstead which you think the best?—I cannot; I can only speak in general terms; I have not had a chart to refer to.

1910. With respect to the harbour, whatever might be done afterwards, it would be necessary to improve this place, so as to make a sufficient dock to connect it with a harbour of refuge?—Yes, exactly; I look upon Seaford Bay as the harbour of refuge, and Newhaven as the harbour of refit.

1911. (*By Admiral Dundas.*) Do you believe that any improvement now in progress, or that you have heard suggested, would ever make Newhaven harbour accessible at half-tide?—I should doubt that; you may get three or four feet more depth of water: when you say merchant-vessels you should say what size. For colliers and small vessels, with judicious management, I think it might be accessible at half-tide.

1912. You have never sounded Seaford Bay?—I never have.

1913. With the prevailing west winds, why do you recommend Seaford, which is on the weather side of Beachy Head instead of Eastbourne Bay?—Vessels, if they were to seek shelter in Seaford Bay, would be able to get to sea more easily than from the eastern side of the Head: I need not tell you that 19 out of 20 of the south-west gales in the Channel terminate with the wind shifting to the north-west; vessels then would be able to keep in smooth water down to the Wight, whereas by getting under way to the eastward of Beachy Head, they would still have the difficulty of rounding that point.

1914. But the wind from the north-west is a fair wind out of Eastbourne Bay?—With strong W.N.W. winds, there would be a heavy sea setting round Beachy Head.

1915. You remember, during war, English cruisers being often driven from their station at Beachy Head by westerly gales?—Yes.

1916. Are you acquainted with the power of steam-vessels?—I am.

1917. Could a powerful steam-vessel keep her station off Beachy Head, by anchoring in heavy gales from the eastward in Seaford Bay, or in western gales in Eastbourne Bay?—Though the greater number of gales in the Channel are from the south-west, it is generally admitted that the most disastrous gales are from the S.S.E.

1918. I want to know if a steamer could keep her station without a harbour of refuge, under the different circumstances of steam and canvass; when we know that a sailing vessel could not?—A steamer could keep her station where a vessel under canvass could not;



but at times the gales from the S.S.E. are so heavy that I think they would drive a steam-boat in.

1919. Such a harbour of refuge near Beachy Head would enable her to keep her station?—Decidedly.

1920. (*By Captain Fisher.*) Have you any other reason for giving a preference to the westward of Beachy Head rather than to the eastward, than that the latter offers a greater facility to leave with a north-wester?—Yes; it divides the distance more equally between the Downs and Portsmouth; has a harbour close at hand (Newhaven) to run into in case of necessity; and has also better holding-ground.

1921. I believe you have given as a reason that Seaford Road has a better anchorage than off Newhaven?—Yes.

1922. (*By Sir W. Symonds.*) I would ask whether you have ever anchored under Dungeness?—I have.

1923. (*By Sir Byam Martin.*) If we were to write to the Harbour Commissioners, to ask if they would be willing to the extent of their funds, to adopt such plan for the improvement of the harbour as might be recommended by Government, would they comply?—I think they would.

1924. Can you state the amount of the income of the Harbour Commissioners?—The paper delivered in will show the amount.

1925. Are the tolls above bridge applicable to the improvement of the lower part of the harbour?—No; they are collected under three different Acts of Parliament, the piers, the upper, and the lower navigation. The lower navigation is in a good condition as to funds, but the upper navigation is not in so good a state.

1926. Then I would ask in what state are they with respect to the banks above bridge, Lewes?—Remarkably good indeed.

1927. And no encroachments?—No.

1928. Supposing an encroachment to be made on the river, would the Harbour Commissioners at once interfere?—Most decidedly.

1929. And would prevent it?—And would prevent it; they have the power under the Act of doing so.

1930. Is it at any time asked of the Harbour Commissioners for permission to enclose?—I do not know of any instance of any inclosure being sought. Just above the bridge they have asked for posts for securing vessels, which have been granted.

1931. If such an application were to be made, would the Commissioners feel themselves warranted in complying with it, without reference to the Admiralty?—I should think they might feel themselves justified in doing it, but I do not think they would do it.

1932. In point of fact, would the Harbour Commissioners ever feel at liberty to permit any encroachment on the river without the consent of the Admiralty?—I think they would, but I cannot speak positively upon it.

1933. Have any enclosures been made in this neighbourhood, on the banks of this river, within the last few years?—I really cannot say whether there have or not; I believe not.

1934. (*By Mr. Walker.*) Is there any land which is under the level of high water which has been reclaimed or enclosed of late years?—I believe there is, but I cannot say in what part; I believe on the eastern side.

1935. Can you tell me how long the marsh-land by the mill has been enclosed?—No, I cannot.

1936. (*By Admiral Dundas.*) Have the Commissioners of the harbour received any rent for any such land enclosed near the mill?—I do not think they have received any.

1937. What right has the miller, Mr. Catt, over the power of the water by his lease?—I do not know anything about his lease.

1938. But, as a Commissioner, you are aware that no improvement in the harbour can be made without the concurrence of Mr. Catt, the miller?—Oh, no; I am not aware of that; I think there is a question as to whether the Crown has not a claim over that land. It has been suggested that the Crown has a power over the marsh-land on the east side.

1939. Mr. Catt is a Commissioner himself?—Yes, and his son too.

1940. I see a clause in your Act, “Commissioners to have no place of trust arising out of the duties;” has that been acted upon?—Yes.

1941. Have any of the Commissioners rented land or houses under the trust?—I believe not.

1942. Does Mr. Catt pay anything at all to the Harbour Commissioners?—I am not aware that he does.

1943. Who is chairman of the Commissioners?—There is no permanent chairman; a chairman is elected when they meet.

[*The Witness withdrew.*]

*William Cole, examined.*

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1944. (*Chairman.*) What is your situation here?—I am carrying on general business as a merchant. I am agent for Lloyds and generally for the whole of the north country shipping clubs. I have had the command of a ship myself in the coasting and foreign trade. I have been a great many years at sea.

1945. Have you any property over the way on the eastern side of the marshes?—On the eastern side, I have not.



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1946. Are you in connexion with Mr. Catt?—I am in partnership in the bonding stores, belonging to the port here; that is on this side of the water.

1947. Do you know how long the land has been enclosed, the marsh on the east side?—Really I cannot say exactly as to the time, but it is within the last 15 or 16 years. I am only speaking from recollection.

1948. Was it enclosed with the consent of the Harbour Commissioners?—I believe not; because, as I am one of the Harbour Commissioners, I know the thing has been very often brought forward by Mr. Blackman as to the enclosure of these salt-marshes, but they were considered the private property of Lord Sheffield, and disposed of by him to Mr. Catt.

1949. Is it generally the case that the proprietors on the banks of the river think themselves at liberty to reclaim the land and enclose it?—There are certain boundary walls from the pier up to Lewes, and without those boundary walls the proprietors of the land of course claim it; but within these boundary walls the Commissioners of Sewers and the Commissioners of the Piers claim it.

1950. Does the water flow within the boundary of these walls?—No; at spring-tides only it flows near the walls.

1951. Then they do not take anything from the river?—No.

1952. Do you think that the Harbour Commissioners would feel themselves at liberty to make enclosures without the consent of the Admiralty?—Decidedly not, I should say.

1953. If any of the enclosures along the river were such as to diminish the back-water, would the Harbour Commissioners feel themselves warranted in granting the request of any landed proprietor to enclose there?—I should think not, the Harbour Commissioners, are very tenacious upon that point; and when I have been at the Commissioners' meeting, the Commissioners have generally felt very anxious about any enclosures; and I know that the enclosure of these salt-marshes has been a bone of contention from time to time. It has been a matter of doubt whether Lord Sheffield was justified in selling that property to Mr. Catt, but the question has not been brought forward. Mr. Blackman, one of the Commissioners, has given repeated notices, but it has never been brought forward.

1954. How long have you been a resident here?—I have been a resident here for 34 years, and I have left off the sea out of that time 25.

1955. Then, as a Harbour Commissioner, can you point out any improvement that you think would be desirable in the interior of the harbour?—I think I can point out a great many. In the first place I would state that we have a powerful back-water, and that the powerful back-water, in case the piers were both extended and widened, would be of sufficient force itself to deepen the channel considerably. And we have land both on the eastern and western side calculated to be excavated and made into floating docks for vessels, I should say of from 17 to 18 feet of water. When Captain Bullock surveyed this harbour, in Sleepers' Hole, he bored down and found nothing but blue clay for 17 feet.

1956. Do you know of any borings outside the harbour?—No, but I have known vessels riding, and when the anchor came up it has been covered with blue clay, within two cables' length of the pier.

1957. Have you ever seen vessels riding out in a gale of wind upon this shore?—I have seen vessels riding out gales of wind when they have been caught, and the wind has come from the south-west. I have known ships to part from their cables, but the anchors did not come home.

1958. We will go back to the harbour; state what the improvements are?—I do not know that I can state any further improvement, only if the piers were extended the water might be deepened, and docks made on the east and west side, capable of receiving vessels of 16 or 17 feet water, and docks and patent slips for repairs might be constructed.

1959. How far would you extend the piers?—They might be extended 400 feet farther into the sea with great advantage and made double their present width.

1960. And, in fact, you mean that the farther they are extended the more will be the scour?—We go off with a sort of slope from our piers, and the power of the back-water is so great that if we were going out 400 feet further, and a breakwater to the westward was erected so as to prevent the beach coming from the westward, the powerful back-water would scour it down to low-water mark, which would give us three feet more than we have now at spring-tides. It would give us from 17 feet at neap-tides and 24 feet at spring-tides.

1961. If we were to write to the Harbour Commissioners, of which you are one to suggest improvements for lengthening the piers out or in any other way, do you think that to the extent of their income they would be likely to comply with the recommendation of the Government?—I think the Commissioners would do everything that laid in their power to meet the views of Government.

1962. But would they do it?—I cannot take upon myself to say that, for the Commissioners are a mixed body, of various classes and very numerous, and I really cannot say what they would do; I believe every disposition would be found on the part of the managing committee.

1963. You find it practically inconvenient having so many Commissioners?—Decidedly so, and men unacquainted with the subject.

1964. Now, as an old sailor and so long accustomed to this harbour, where do you think a breakwater might be placed with the greatest advantage?—I should recommend the breakwater being carried out off Seaford Head, eastward of the harbour.

1965. How far is Seaford Head from the Pier Head at Newhaven?—About three miles; and then on the west side of the pier, I would recommend its being carried off above Woolmore Point.



1966. (*By Mr. Walker.*) How far is that?—About a quarter of a mile.

1967. (*By Sir Byam Martin.*) Then what you are now proposing is to embrace a space of three miles?—It embraces a space of three miles.

1968. How far would you carry the breakwater off on the Woolmore Point?—I should say, if you carry the breakwater off Woolmore Point to enable ships of any burthen to ride under shelter in six or seven fathoms of water it must be carried off a mile or a mile and a quarter.

1969. What is your object in proposing this sort of breakwater so extensive? Is it because of the quality of the bottom at any particular part, or not?—I think the bottom is good all over, as I have stated; I have seen ships get their anchors here not two cables' length from the Newhaven Pier covered with blue clay, and I believe the ground to be of the same description from Woolmore Point to Seaford Head.

1970. (*By Admiral Dundas.*) You are in the Committee of Management. In what state are the funds?—I think we are now about 4900*l.* in debt.

1971. Are the books of the Harbour Trust laid before the Quarter Sessions at Michaelmas every year?—No, they are not.

1972. Have you ever brought forward any of the suggestions for the improvement of the harbour at the meetings of the Commissioners, and what has been the result of your endeavours?—I have since I have been in the commission. The first improvement that I was the means of bringing forward, with the assistance of Mr. Catt, was the extension of the eastern pier even with the western. Mr. Cubitt was the engineer. A committee was appointed to carry it into execution, and before that committee proceeded with it they thought it right to call Mr. Cubitt in to take his opinion upon the subject. That would be eight or nine years ago; he approved of it, and it was carried into execution. Before the extension of the eastern pier I have known the banks of beach alongside of the western pier to be so high that I have jumped over from the western pier upon the beach; and then, when the eastern pier was shorter than the western pier, of course when the water got down to the end of the eastern pier the scouring power of the water was done; it there expanded itself. And this bank of beach used to run out from the west pier in an easterly direction; and I have myself walked out upon the bank of beach sufficiently to the eastward to see up to the eastward side of the eastern pier; but when the eastern pier was extended even with the western pier, that brought the scouring power of the water down upon the bank of beach; and in less than 18 months after that pier was extended, where we had had 14 or 15 feet of beach lying along the western pier, pilot-boats lay afloat at low water. The extension of the pier was about 120 or 130 feet, at a cost of above 4000*l.*

1973. Have you followed up any other of your suggestions?—The next thing that was suggested was the erection of the western groyne, westward of the west pier. I brought it forward, and was defeated in two instances, and gained it on the third; and it is now acting admirably well.

1974. Are you acquainted with Mr. Catt's lease, and what power he has over the water?—No, I am not; but I can only observe that I do not think the enclosure on the part of Mr. Catt has been the least detrimental to the harbour; in fact, I think it has been beneficial.

1975. Perhaps you will explain in what way?—Because, before these salt-marshes were enclosed, the tides flowed over them, and probably at spring-tides there might be 17 inches or two feet water; and at neap-tides they never were overflowed. The water used to drain off probably at first-quarter ebb, and then I conceive there is no scouring power; when water is at that height there is no scouring power going forward at the mouth of the harbour; but since these salt-marshes have been enclosed, the water has been compressed for the purposes of his mills, and let loose probably at two-thirds ebb; and then the water has come down in conjunction with the powerful back-water, and has assisted, in my opinion, in scouring.

1976. Do you consider these salts the property of an individual or of the Commissioners?—I think the Commissioners cannot claim it, because Lord Sheffield has disposed of it; but on the western side it is doubtful. There are two bonding ponds for timber, and the Commissioners make the proprietors pay them a nominal rent to acknowledge that the Commissioners have a power over it.

1977. Are you speaking of Sleepers' Hole?—Yes; the old harbour used to run in that direction, round Sleepers' Hole.

1978. (*By Sir Byam Martin.*) No acknowledgment is paid on the other side?—No acknowledgment; in fact Mr. Catt has bought it, and claims it as his property.

1979. (*By Admiral Dundas.*) With the prevailing west wind on this coast, why do you recommend Seaford, which is on the weather side of Beachy Head for a breakwater, and not Eastbourne Bay, which is on the eastern, and consequently the lee side?—I am not recommending our bay in preference to it for a westerly wind.

1980. In the event of a war it would be necessary to have a harbour on this coast where steam-vessels could be sheltered from wind and weather, constantly ready to slip at a moment's notice, for the protection of the trade; to combine that object with a harbour of refuge for merchant-vessels, on which side of Beachy Head should such a harbour be constructed?—Why, I should say to the westward of the Head; we are naturally protected from easterly winds; the only advantage Eastbourne Bay has is with westerly winds.

1981. By the Head?—Yes, by the Head; and therefore they would require a breakwater to protect them from easterly gales, as much as we should require to be protected by a breakwater from westerly winds. Then, on the other hand, I should say as a harbour

*William Cole.*

18th May, 1844.



William Cole.

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of shelter, with a wind from the S.S.W., blowing a hard gale, after you get to the westward of the Head, ships could hardly clear the land upon either tack; therefore that renders a harbour of refuge decidedly necessary on this side of the Head. Then, on the other hand, I think it is more central between the Downs and Portsmouth.

1982. Which is the prevailing and most tempestuous wind on this coast?—From the W.S.W.

1983. Then, as a sailor, supposing the two breakwaters, one at Seaford with a protection from the west gales, and another at Eastbourne protected by the land on the west and by a breakwater on the east, which of these two would you take shelter in in a heavy gale?—If there was a breakwater of the description you name to the westward of Newhaven Piers that I could take shelter under, I would decidedly come here in preference to going round the Head.

1984. Is there any reason for your dislike to go round Beachy Head from the fear of the Sovereign and other shoals?—There are the Boulder Banks and other shoals which I should dislike. I should go within the Sovereign Shoal.

1985. Have you ever sounded on this side of the Bay?—I have sounded this Bay many times, and I have been riding there many times.

1986. (*By Sir Henry Pelly.*) Supposing a breakwater which would protect vessels from wind to be erected on the east side, and one on the west side of the Head, and you are seeking a harbour of refuge in consequence of a heavy westerly wind, being bound to the westward, whether would you take shelter in the one at the east or the one at the west?—If I could gain the advantage of the western one, I should take it decidedly.

1987. I am supposing that you are running up and off the Head, and the wind strong from the west, and you are seeking shelter, and there are harbours at both places, whether would you take the one on the eastward or the westward?—The westward, and then I should avoid those banks; and to the westward, I have regular soundings, and no shoals, and good sea room.

1988. (*By Captain Fisher.*) Do I understand, speaking as a seaman only, and not with regard to the construction of the breakwater, but as a seaman going down Channel, and having got as far as Beachy Head, that if there were two harbours of refuge, one on the east and the other on the west, that you would prefer seeking the one on the west?—Decidedly so.

1989. Now I would ask whether you do not conceive that in running to the harbour on the west that you are placing your ship in greater difficulty than if you ran to the eastward, supposing them to be equally good?—I think, not so much.

1990. In making one to the westward, do you not necessarily make the land to the westward of that harbour?—Yes.

1991. In making the land to the westward of that harbour with a westerly wind, would you not have a difficulty if you were obliged to sail for, and not able to round Beachy Head?—I should say that nine times out of ten you would make the western land better than you would Beachy Head.

1992. Then, I ask again, supposing your ship was in any difficulty in making the harbour to the eastward, have you not the sea open, and you can place the ship in perfect safety?—Decidedly so, I should say more so to the westward of the Head than to the eastward.

1993. But I ask, if by an accident you were prevented getting into the harbour, would you not, in reaching the westward, place your ship in great danger and difficulty; in making your harbour to the eastward you would have room to drift, and your ship would be in safety?—I conceive that if it were thick weather, and I could not make the land properly, and I wanted to make use of the western harbour of refuge, I should think myself in a better position to the west of the Head than I should to the east of it; and I should decidedly take the western in preference to the eastern as a port of safety to run for.

1994. (*By Sir Bryan Martin.*) Would you state what is the revenue derived from this harbour?—I have put in a letter from the clerk which gives the revenue for the last seven years, from 1836 to 1843, and that includes everything.

1995. Are the tolls above bridge applicable at all to the pier?—Not at all.

1996. (*By Lieut.-Col. Alderson.*) How long have you been agent for Lloyds, and which side of Beachy Head has the greater number of wrecks taken place during that period?—I have been agent 13 years, and the greater number of wrecks have been on this side than the other; but that has decreased very much since the erection of Beachy Head light. I succeeded Mr. Stone, who was comptroller of the customs here and agent for Lloyds, and during the time that he was agent here there was property lost between Beachy Head and Newhaven piers to the amount of 600,000*l.*, and Lloyds have proof of that.

1997. Can we obtain a proof of that?—I cannot furnish it; Mr. Marriott was chairman at Lloyds at the time, and the amount was forwarded to Lloyds by Mr. Stone.

1998. Will you state the dates that you are speaking of?—I have been agent 13 years, and my predecessor was agent about 13 or 14 years. There is only one thing I would wish to observe as regards this harbour and Shoreham Harbour; I am agent for five clubs that ensure mutually among themselves ships to the amount of one million of money, and they allow ships of 450 tons, without any extra average, to come into Newhaven; but if they go to Shoreham with above 200 tons, they are subject to 7½ per cent. extra average.

1999. (*By Admiral Dundas.*) To what do you attribute your decrease of trade here?—I attribute it in a great measure to the railroad. I can only tell you, in one article I have a vessel constantly in the Rotterdam trade, and we paid about two years ago 4000



guineas duty on Dutch cheese; it is now about 2,500, and I attribute the decrease in the revenue to the communication Lewes has with the line of railroad from Brighton and London, by which goods are brought.

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2000. I see the number of vessels from foreign parts in 1841 was 91, and in 1843 it was reduced to 22?—That was in consequence of the making of the Brighton railroad. Out of those foreign vessels we had 70 or 80 coming from Caen with stone for the viaduct, and there was a great consumption of timber. That was the largest revenue we ever received at this port.

2001. Are you likely to have a railroad to this port?—I am not aware of it.

2002. What is the distance of the proposed line of railroad through Lewes, to Newhaven?—7 miles.

2003. Are you likely to have that?—I think there is very little doubt of it.

[The Witness withdrew.]

Lieut. Fothergill, R.N., examined.

Lieut. Fothergill,  
R.N.

2004. (*Chairman.*) State what you are?—I did command the ‘Stork’ for three years on this station; I am not in command of one at present. The ‘Stork’ was on this station cruising between Newhaven and Dungeness; and I have been 7 years cruising in the Channel.

2005. Were you often at anchor in this bay?—Very frequently in this and Seaford.

2006. What difference is there in the quality of the bottom between Seaford and Newhaven?—Seaford is stiff blue clay, and considered better holding-ground than nearer Newhaven.

2007. We have been told, by a person who has been accustomed to anchor fronting Newhaven, that his anchor has come out with stiff blue clay upon it?—There may be spots of that kind; I do not consider the holding-ground good.

2008. But the general character of Seaford Bay is better than the front of Newhaven?—Certainly.

2009. How often have you anchored at Seaford?—A hundred times.

2010. Did you ever anchor there in blowing weather?—I generally anchor there with an east wind.

2011. How many times off Newhaven?—Thirty or forty times.

2012. And speaking with that experience, you say the anchoring-ground off Newhaven is not so good?—Not so good holding-ground as off Seaford.

2013. But should you describe it as a bad holding-ground?—No, I should not call it a bad holding-ground.

2014. And after your long experience on the coast as a cruizer, if you had to name the position where there should be a harbour of refuge, would you prefer it on the west side, or the east of Beachy Head?—I think the east would be more easily obtained. You can work to the westward easier; it is more difficult to work round Beachy Head; but at the same time, the Seaford Road is better. I have seen 200 sail lying at anchor in Seaford but had the wind come in south, not one-half of them could have worked off shore.

2015. The question is, which would you prefer, suppose you were to have an artificial harbour constructed, which would you prefer, the east side or the west side?—I think the east side would block up.

2016. But suppose a harbour were to be constructed, which side of the Head is best, the most convenient for the navigation of the Channel?—The west side; because the homeward bound ships and others cannot work round Beachy Head against an east wind; and there is no safe anchorage with that wind (not even in the Downs) when up past Beachy; consequently the trade-ships anchor in Seaford Bay, or work about the Channel at the risk of being wrecked on the coast of France; but were there a refuge harbour in Seaford Bay, they would be safe in all winds, and protected from an enemy in time of war; as there would be water for the largest steam-frigate, or even a line-of-battle ship, and with excellent holding-ground.

2017. (*By Admiral Dundas.*) In the event of war it would be necessary to have a harbour on this coast where steamers could be sheltered from all winds and weather, constantly able to slip at a moment’s notice for the protection of trade and the protection of the coast, to combine that object with a harbour of refuge for merchant-vessels, on which side of Beachy Head would you construct that harbour?—On the west side.

2018. (*By Captain Washington.*) Have you any objection to state your reasons?—I think, in the event of a war, Seaford Bay, as a place of refuge with an east wind; but if the wind came from the south, they would not be able to work off shore. I think at least 100 out of 200 would come on shore; if there was a harbour of refuge at Seaford, they would not have occasion to move with a south wind; if the harbour of refuge was at Newhaven, they would only have occasion to get under way and enter it.

2019. (*By Admiral Dundas.*) Are you acquainted with the power of steam?—Not much.

2020. You remember that, during war, cruizers were driven off this station by westerly gales?—Yes.

2021. Do you consider that a powerful steamer could keep her station off Beachy Head by anchoring in western gales in Eastbourne Bay, and in eastern in Seaford Bay?—Eastbourne Bay is bad holding-ground.

2022. In Eastbourne Bay could she find shelter from the west?—I do not think she



Lieut. *Fothergill*.  
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could; she could not lie there for a moment should the wind come to the southward of W.S.W., the holding-ground is so bad. I am not speaking of Langley Point.

2023. But you consider the ground in general bad to the eastward of Beachy Head?—Yes.

2024. (*By Captain Washington.*) Do you think the shoals within the Royal Sovereign Shoals are any objection to an asylum harbour to the eastward of Beachy Head?—I do.  
[*The Witness withdrew.*]

Lieut. *Hemer*,  
R.N.

Lieut. *Hemer*, R.N., examined.

2025. (*Chairman.*) State what you are?—I command the “Lively,” revenue cruizer, and have commanded her since July, 1839.

2026. At what station?—The first 12 months I was stationed on the flats close up to Sheerness. I came to sea in this vessel in September, 1840, and have been cruising between South Foreland and Hastings.

2027. Have you been in the habit of coming round the Head?—Only making a voyage from Hastings to Portsmouth.

2028. Which situation do you think most eligible for a harbour to be made, on this side of Beachy Head or on the east side of it?—I should say at Langley Point.

2029. And what are your reasons?—Because there is deeper water close to the beach there than there is here.

2030. Perhaps I should explain to you, that the object of the harbour is for the accommodation of a squadron of ships-of-war, the largest steamers, for the convenience of the trade in general as a port of refuge, and to watch the opposite coast; for this purpose, which do you consider the most convenient situation, bearing in mind as a port of refuge also for the trade?—Why I mention Langley Point is, that I do not conceive that vessels can always reach Newhaven; vessels very often reach Eastbourne and get a flood-tide. They cannot get round Beachy Head with a westerly wind.

2031. You must bear in mind, when we are speaking of ports of refuge we are speaking of a port of refuge for vessels whether they are bound up or down Channel, and to be accessible at all times of tide?—I do not see that there could be much difference in the two places.

2032. And do you consider it best holding-ground on this side of Beachy Head or the other?—This side, Seaford Road.

2033. (*By Admiral Dundas.*) Suppose a merchant-vessel lying under a breakwater in Pevensey Bay, in a severe gale from W.S.W., it veers round to the north-west, will she clear Beachy Head?—Yes.

2034. If you were five leagues to the west of Beachy Head, and a stormy night coming on with rain, and you had it in your power to choose an anchorage under a breakwater off Seaford, or another in Pevensey Bay, which would you go to?—I would go to neither.

2035. But suppose you did go to one?—I would go to the one in Seaford.

2036. Why would you go to neither?—I would rather go to Dungeness Road.

2037. And would prefer Seaford to Pevensey?—Yes, because there is better holding-ground.

2038. But when you were asked a question just now where you would construct a harbour, you said Langley?—Yes, supposing there was to be a harbour only, not for a breakwater.

2039. (*By Admiral Dundas.*) In the event of a war, it would be necessary to have a harbour on this coast near Beachy Head, where steamers could be sheltered from all winds and weather, constantly ready to slip at a moment's notice for the protection of the trade and the defence of the coast. To combine that object with a harbour of refuge for merchant-vessels, on what spot on either side of Beachy Head would you form a harbour?—Then I would say the west side. I said Langley Point as a harbour only, but I did not understand a breakwater outside it.

2040. (*By Sir Byam Martin.*) Would you prefer having a harbour in Seaford; I am speaking still of a harbour to be constructed, and a breakwater, at Seaford or Dungeness?—If you could construct a harbour, I prefer Dungeness.

2041. Why?—Because it is nearer the French coast in case of a war. And often have I seen 200 sail go from Dungeness, and half of them come back again not being able to get round the Head against a flood-tide.

2042. (*By Captain Fisher.*) Supposing that such a harbour as has been described to you is to be constructed, accessible at all times of tide and all circumstances, anywhere between the North Foreland and Portsmouth; where would you prefer its being constructed for the trade generally, and for armed steamers?—I am so little acquainted with this part of the coast, I cannot say.

2043. (*By Mr. Walker.*) If you know between the South Foreland and Dungeness well, what is your opinion of Dover for the purpose named?—I should not like it.

2044. Why?—Because you cannot get into Dover at all times.

2045. (*By Sir Byam Martin.*) Suppose a harbour built round Dover?—It is bad anchorage in Dover. I do not like the beach; that is, as it is now.

2046. Why is it bad?—It would be as good a place as any other if a harbour was made there. If a harbour was made there, I would as soon take a vessel into it as into Dungeness Roads.

2047. (*By Sir W. Symonds.*) Should you think it as safe for the anchorage in it as Dungeness?—No, I should not; I would rather anchor in Dungeness than in any other place on the coast.  
[*The Witness withdrew.*]



Lieut. *George Franklyn*, R.N., examined.

Lieut.  
*George Franklyn*.

18th May, 1844.

2048. (*By Captain Washington*.) You are on the Coast Guard?—I was at Newhaven four years and a half in the Coast Guard.

2049. During the time you were in the Coast Guard, had you any opportunity of ascertaining the nature of the holding-ground?—Yes, I have been in Seaford Roads when vessels could hardly get their anchors. There is great difficulty, it being a strong blue clay.

2050. (*By Sir Byam Martin*.) What do you say of the road to the westward?—The ground is not so good; when you get a little way to the westward of the piers, fishermen are obliged to haul their trawls up there.

2051. (*By Captain Washington*.) Did you assist Captain Bullock in his borings?—Yes, I was with him once, and lent him all the assistance I could.

2052. Did he bore at all outside the harbour?—Not to my knowledge; he bored a great deal where he thought there would be a good place for docks.

2053. State what advantages Newhaven possesses over other pier harbour?—The advantage Newhaven Harbour possesses in gales from the S.S.W. to west is that the tide makes westward in the bay shortly after half-flood, consequently vessels taking it in bad weather have not that difficulty there is at Dover and Ramsgate, where the tide runs rapidly past the piers to the north-east.

2054. Is there not rocky ground close in shore in Seaford Bay?—I have fished over the whole of Seaford Bay, and have found a clear ground with a slight coat of sand over the clay.

[*The Witness withdrew.*]

## WEYMOUTH.

28th May, 1844.

Sir T. BYAM MARTIN, in the Chair.

Lieutenant *William Marshall*, R.N., examined.

Lieut. *W. Marshall*,  
R.N.

28th May, 1844.

2055. (*Chairman*.) What vessel do you command?—The “*Adelaide*” revenue cruizer.

2056. How long have you been on the Portland station?—Seven years.

2057. Have you ever served in square-rigged vessels on this station?—No.

2058. Have you been often in during the night?—Frequently.

2059. And without any apprehension as to danger?—The Shambles offer the principal danger.

2060. Is the Race very dangerous at night; is the danger increased by it?—Yes, and should be avoided in blowing weather.

2061. Do you think if a breakwater were made here, as shown in plan No. , that merchant-ships would run any risk in running in during a gale?—None, not even at night.

2062. Have you found that in south-west gales that the gusts are strong off the land?—Yes, off Portland.

2063. And what distance off do they reach?—About a mile.

2064. Have you known many vessels in easterly winds go ashore?—Yes, several; not more than three or four at one time; not more than ten altogether.

2065. Do you think that if there were a breakwater, vessels would go into the West Bay in an easterly wind, or prefer the protection of the breakwater?—I should say they would prefer the breakwater, because, if the wind were to fly round to the southward, they would get embayed on the west side.

2066. Have you known vessels get embayed there?—Yes, several; and all hands perished.

2067. Do you know Portland as a holding-ground?—Yes.

2068. What sort of bottom is it?—Three different strata of clay; the inside, in about five fathoms, blue clay; the outside not so good, but still clay.

2069. What is the general character of Portland as a holding-ground?—Good; but much injured by vessels throwing ballast overboard.

2070. Have you any idea of the number of vessels that frequent Portland during the year?—No; it depends on the demand; but I should say about 300 or 400.

2071. And they all throw their ballast overboard?—They do always in the Roads.

2072. Has any person a control over the Roads?—Yes, the Trinity Commissioners. The Collector of Customs is one.

2073. Have you ever heard of their interfering to prevent ballast being thrown over?—No.

2074. Have you heard, as a common observation, that the Roads are thus much injured?—I have.

2075. Suppose a breakwater were constructed, do you think a passage for exit and entrance between it and the shore would be desirable?—With wind at the north-west, I do; but for general purposes, I do not; meaning, that should a vessel part in a north-west wind, she could then get out in place of running on the breakwater.

2076. Suppose a vessel coming in with a south-west gale, could she anchor in the bay, not being able to get round the breakwater?—She must run in to Weymouth Roads.

2077. Would vessels coming in at night go to the east of the Shambles?—It would depend whether they were acquainted with the passage between the shore and the Shambles.

2078. What are the bearings for knowing when you are round the Shambles?—Wyke Church just open with Portland by day, and at night keeping from two to three miles off, until the lower light bears north-west and by west.



Lieut. *W. Marshall*,  
R.N.  
—  
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2079. How do you know when you are sufficiently to eastward of the Shambles to bear up?—Judging by the distance from the lights.

2080. Would not that be likely to convey vessels too much to leeward in south-west gales?—No, with a south-west gale they would go several points free. It is quite smooth under the Shambles.

2081. (Sir *Howard Douglas*.) If there were an opening and a harbour light, would not that with the Portland light give a safe direction for entrance?—I think it would.

2082. (Admiral *Dundas*.) Do you think an opening should be left for small craft and boats?—It would be convenient for the fishermen especially.

2083. From the set of the tide out of the bay, a passage 100 feet wide would enable the stone-vessels to work through?—There is but very little tide in Portland Bay; it runs nine hours ebb, and it would depend upon the weather.

2084. You are then rather in favour of an opening?—Yes, certainly; for small vessels, but not for large, as the winds any way to the southward or westward are very baffling.

2085. (Chairman.) You said that an opening was only necessary in case of vessels getting away from their anchors in north-west winds, and that otherwise you appeared to infer that there was no great advantage, do you know of any disadvantage?—No, none.

2086. (Sir *Henry Pelly*.) Have you ever known vessels part in north-west gales?—Never part; but I have known them drive, being short of cable.

2087. (Captain *Fisher*.) Would a western entrance much facilitate vessels, particularly in fleets outward bound, leaving the harbour with wind at east, and thus enable them to make their passage to sea and down Channel quicker than otherwise?—No, the wind would be right on; consequently, there would be a heavy sea, and attended with danger, as the land at Portland runs south-south-east.

2088. Supposing only one entrance to the north-east, would not vessels in strong south-west and westerly winds be obliged to run far to leeward, and thus only reach the lee part of the harbour?—No, I consider they could come round the breakwater, and make a tack in.

2089. In running in for shelter with wind strong from west-south-west and west, would vessels come to leeward of the Shambles?—Yes, I think they might; but they would sooner avoid it.

2090. (Sir *William Symonds*.) Do you not generally find the wind baffling near high lands?—Yes.

2091. Suppose the wind to be at east, and a heavy-laden merchant-vessel having to work out of the west or inner passage, would she not, on getting outside, find a lee-shore on Portland, on the larboard tack, and the breakwater itself on the starboard?—Yes, she would.

2092. How does the east end of the Shambles bear from Portland Roads?—South-south-east, half east.

2093. Would not a western passage, if broad enough for ships to work through, expose vessels to a heavy sea and wind when blowing from south and east-south-east, in that part of the Roads best adapted for small merchant vessels, where, I think, you say the best holding-ground exists?—At south-south-east, the sea does not come in, because the Shambles in a measure offers a protection, but at east-south-east it would be unsheltered.

2094. (Mr. *Walker*.) What is the least depth at low-water spring-tides on the Shambles?—I have never come over less than three fathoms.

2095. The lift of tide being nine feet at springs, you have four and a-half fathoms at high-water springs?—Yes.

2096. You said before that, inside the Shambles in south-west winds the water was smooth?—Yes, it acts as a breakwater.

2097. What winds, at present, are the Roads most exposed to?—From south-east to north-north-east.

2098. (Admiral *Dundas*.) In time of war, in the present state of Portland and Weymouth Roads, could a fleet of men-of-war and armed steamers rendezvous there in all winds and weathers, to watch the opposite coast, or to collect convoys; or would it be beneficial to the objects I have stated, to have a breakwater made in Portland Roads?—I think that, as at present they would run a risk, a breakwater would ensure this object at all times.

2099. Suppose a ship anchored under the proposed breakwater in a west-south-west gale, and the wind flew round to the northward, would it not in such a case be difficult for that ship to get sea round the north end of the breakwater, and would not a passage towards the south end be most useful?—Yes.

2100. (Captain *Fisher*.) Would the wind at east enable a ship to sail from such a harbour through the western passage, and weather round Portland, when she could not work round the north end?—No, I consider that there would be a great risk, as Portland would be a lee-shore.

2101. (Chairman.) Suppose a breakwater to be formed with an opening in the middle, would not that obviate all the difficulty or inconvenience you mention with respect to a lee-shore, with the wind at east?—Yes, I think it would.

2102. With reference to a former answer you gave, is it not likely that ships at night running in for Portland would go in between the Shambles and Portland rather than go to the eastward?—It would depend whether they were acquainted with the coast or not, as in blowing weather the Race and Shambles frequently meet.

[The Witness withdrew.]



Mr. *Lowe*, Chief Mate and Commander of the Revenue Cruizer “*Petrel*,” examined.

Mr. *Lowe*.

28th May, 1844.

2103. (*Chairman*.) How long have you been on this station?—Eight years.
2104. Are you in the habit of coming into Portland Roads?—Yes.
2105. You always approach at night without fear?—Yes.
2106. Would you in a large ship?—Yes, if clear weather.
2107. Do you think in south-west gales outward-bound vessels would take shelter here?—Yes.
2108. And do they so now?—Very frequently, by night and day.
2109. What is the quality of the bottom in Portland Roads?—In six and seven fathoms it is good holding-ground; but nearer in shore, in four fathoms, it is not so good, in consequence of the ballast being hove over there.
2110. How many vessels come in in ballast during the year?—I should say 200; and they all throw over their ballast as a regular practice.
2111. Have you ever known any remonstrance made?—No.
2112. Is there any harbour-master?—Not in Portland, but in Weymouth there is; Mr. Terrard is harbour-master there.
2113. What is the quality of the holding-ground in Weymouth Bay?—Good; as good as Portland.
2114. Have you ever rode out a heavy gale in Weymouth Roads?—No; when it blows from eastward we beat out.
2115. Have you ever rode out a gale in Portland Roads?—Yes; in all weathers.
2116. Have you ever known vessels part in Portland Roads?—Yes; one winter, seven years since, three went ashore; they were stone-vessels.
2117. Have you known many vessels anchor in the West Bay or Chapel Cove?—Yes, many.
2118. Have you known instances of the wind coming round on them when anchored there, and what was the consequence?—They all got out; none went ashore.
2119. Suppose a passage between the shore and the breakwater, would it be a convenience for the trade as an exit and entrance?—Yes, it would.
2120. Are the squalls heavy off Portland in south-west gales?—Yes.
2121. Then that would be an objection to vessels going in?—Yes, it would; but an advantage to vessels going out, as they could then run out when the wind was from the north; when they could not beat round the north end.
2122. (*Sir Howard Douglas*.) In running in from the westward with a strong south-west wind, would you run in between the Shambles and Portland?—Yes, I would; but in a large ship I would prefer running round outside.
2123. Would you prefer running into the breakwater by a southern entrance, or would you go round the north end?—I should go round the north end, and get into safe anchorage at once.
2124. (*Admiral Dundas*.) In the event of war, could a fleet of men-of-war and armed steamers keep their station, as Portland and Weymouth Roads now are?—I think they could not in all weathers.
2125. Would a breakwater enable them to do so in all winds and weathers?—Yes, it would so.
2126. Do you think, for the convenience of small craft and boats, that a passage should be left between the north end of Portland and the breakwater?—Yes, it would be a convenience.
2127. (*Sir Howard Douglas*.) If a harbour were constructed, would it be much frequented by the trade in easterly gales?—Yes, in any winds.
2128. Would the Portland Roads be preferred, under these circumstances, to the West Bay?—Yes, certainly.
2129. (*Chairman*.) Which would you prefer, an opening in the middle of the proposed breakwater or on the south end?—In the middle, as giving more shelter for small craft in shore.
2130. (*Captain Fisher*.) Are you of opinion that a small entrance on the westerly end of the breakwater would enable ships to leave the harbour in fresh easterly winds when there might be a difficulty in their getting out at the north-east end?—Yes.
2131. Would not ships going through this western passage with the wind at east be enabled to fetch round Portland and run down Channel?—Yes; but with the wind to the southward of east.
2132. (*Sir William Symonds*.) Looking at the chart, and considering the wind from east-south-east, would you in your cutter, or any merchant-vessel, at night time, go out by a narrow inner passage between the breakwater and the shore, or would you hug the lee or west side of the breakwater, standing to the northward and tacking round the north end of the breakwater?—In my cutter I should not hesitate; but in a merchant-vessel I should go round the north end of the breakwater.
2133. Is not the wind generally baffling in the neighbourhood of high land?—Yes.
2134. Does not the Race off Portland change its position sometimes and create doubt and embarrassment as to the passage between it and the Shambles, particularly to strangers, and when the tide is running to the eastward?—Yes, it does, and occasions difficulty.
2135. Would not a southern or inner passage allow a heavy sea to enter and expose the inner harbour, where merchant-vessels lie, to damage?—Yes.



Mr. Lowe.

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2136. What have you to direct you in coming in between the Shambles and the Race of Portland?—The Portland Lights; the high light open to the eastward of the lower.

2137. (*Chairman.*) With reference to your observation that the southern passage would expose vessels in a south-south-east gale, would the middle passage have that effect?—I do not think it would.

2138. (*Admiral Dundas.*) If there should be a second opening, where would you have it, between the south end and Portland, or in the middle of the proposed breakwater?—In the middle.

2139. Would it not inconvenience the fishermen if there were no opening between the land and the southern end of the breakwater?—Yes, it would make a longer pull for them.

2140. (*Mr. Walker.*) Have you much considered the subject of a breakwater at Portland?—Not much.

2141. Have you ever heard of a passage between the land and the breakwater, or in the middle, before the present time?—I never have.

2142. Comparing the advantage and disadvantage of having a passage, do you, on the whole, consider it an advantage?—I do; if there were to be one in the middle.

2143. Of what width?—Sufficient for large ships under all circumstances.

2144. (*Lieutenant-Colonel Colquhoun.*) Of what is the Shambles composed?—Of shingle.

2145. Is it liable to any material alteration from shifting?—From my own observation, I cannot say.

[*The Witness withdrew.*]

Mr. Joseph Read.

Mr. Joseph Read, examined.

2146. (*Chairman.*) What has been your occupation?—In the merchant service 30 years.

2147. In what trade?—Coasting in the Irish trade chiefly, but, belonging to Portland Head.

2148. Are you a pilot for Portland Head?—There are no branch pilots.

2149. Have you ever brought any large ships into Portland Roads?—I have.

2150. Should you have any difficulty in bringing a large ship in in the night time?—No.

2151. Supposing coming in in a south-west gale, would you come between the Shambles and shore, or to the eastward?—It would depend on tide; on flood I should come round the Shambles.

2152. Are the marks for the Shamble the same as when you knew it 30 years since?—Yes.

2153. Coming round the east end of the Shambles, what are your marks to know when you are to the east?—By the distance run.

2154. What sort of bottom in Portland Roads?—Blue clay; good holding-ground.

2155. In Weymouth?—Hard sand; not so good.

2156. Have you ever known any vessels drive on shore in Portland in easterly gales?—Yes, many; I may say seven in one gale.

2157. Do you think if a breakwater were constructed here, that the trade of the Channel would use it much as a refuge?—I do, certainly. Many ships beating down Channel as far as the Lizard and Start are obliged to try back for the Downs.

2158. What is the greatest number of vessels taking shelter in S.W. gales?—Often from 60 to 70 at once.

2159. Is it common at all times to see vessels coming in in S.W. gales?—Yes, in the winter particularly.

2160. Do vessels often anchor on the west side?—Yes, when the wind is from N.E., but very seldom ships, only coasters.

2161. But if a breakwater existed on the east side, it would be preferred, and much used?—Certainly.

2162. Do you suppose much damage done to the Roads by ballast being hove overboard?—Yes, a great deal.

2163. Has any person any authority to interfere?—I cannot say, unless the collectors may have.

2164. Has this been always the custom?—Yes, ever since I remember.

2165. (*Sir Howard Douglas.*) Vessels having taken shelter in Portland Roads in strong S.W. gales, and the wind flying round to E.N.E., or east, would not a merchant-vessel find difficulty in getting out?—Yes, great difficulty.

2166. And that danger would be obviated by constructing a breakwater?—It would.

2167. (*Admiral Dundas.*) Do you think a passage in the south end of a breakwater would be of great use to all vessels, particularly to small craft and fishermen?—No, I do not; very much against them.

2168. Would you have any opening?—No, none at all.

2169. In the event of war, could a fleet of men-of-war and armed steamers be able to keep their stations here, as Weymouth and Portland Roads now are, in all winds and weathers, and at all times?—I think there would be a great difficulty in getting out; but if there was a breakwater, they could get out at all times.

2170. Supposing it blew very hard from N.N.W., and a ship could not get out, would she not be able to do so by a southern passage in breakwater?—No; I should not like to risk it; besides, such an opening would admit a heavy sea to the injury of small craft in the inner harbour.



2171. You have stated your objection to an inner passage, have you any objection to a centre passage?—The force of the S.E. will send a heavy sea through, and disturb the inside of the breakwater.

Mr. Joseph Read.

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2172. (Sir *Henry Pelly*.) In your evidence you state that you have known vessels get as far down Channel as the Lizard, and return to the Downs when the wind came to blow from the south-west strong, can you state any reason for their not taking refuge in Portland Roads?—It must be owing to the darkness of the night, or being unacquainted with the coast.

2173. That would be the same whether a breakwater were there or not?—Certainly.

2174. (Mr. *Walker*.) Then you consider Portland Roads to be a safe refuge in south-west winds in its present state?—Yes.

2175. To what winds is it exposed?—From east to south.

2176. (Captain *Fisher*.) Would not an inner entrance give much facility, particularly to fleets outward bound leaving the harbour with the wind at E.N.E., and thus enable them to make a passage to sea and down Channel when they might not be able to go out by the north-east end?—No; they would go out by the north-east better; because by the inner passage you could not clear Portland.

2177. (Sir *William Symonds*.) You consider that two miles or more of space between the north-east end of breakwater and the Weymouth coast ample room for vessels to work to windward when the wind is blowing fresh off the land, and consequently there is no sea of importance?—Plenty of room.

2178. (Chairman.) How does the tide set from Weymouth towards Portland Head?—Directly across, for the north-east part of Portland after high water.

2179. Do you know whether the sand in Weymouth Bay has been moved by north-west gales?—I think it has not.

2180. What would be the effect caused by the proposed breakwater on the tide?—It would strike about the middle of breakwater.

2181. At what rate does it run?—About half a knot.

2182. Has the ground over which the tide flows at the back of the town been enclosed or embanked?—It has; about five or six years since.

2183. Do you recollect Weymouth Harbour being dredged?—Yes, about three years since.

2184. Has its depth increased?—I cannot say.

2185. (Captain *Washington*.) What would be the effect of making an opening 100 yards wide in the Chesil Bank?—A very bad effect.

2186. State your reasons for thinking so?—First, I think it would be almost impossible for any building to stand there, and I doubt the possibility of getting a foundation, as the water is so deep on the west; and, again, if a ship is ever caught in the west bay in a westerly gale, that no ship could run for such an opening.

2187. Are you aware that the water on flood-tide is said to stand much higher in West Bay than in East?—Yes, I should suppose a difference of 5 feet.

2188. With this difference of level and nine hours' flood, would it not tend to keep the passage open?—I think not.

2189. Would it injure the town of Weymouth?—I think so. The tide would come in in such strength that the houses would be washed away.

2190. (Admiral *Dundas*.) Are you well acquainted with the coast from Scilly to the North Foreland?—Yes, I am.

2191. Which side of Beachy Head would you construct a breakwater for the advantage and protection of the trade, and to enable men-of-war and steamers to keep their stations in war?—I should say on the east side, about Eastbourne.

2192. Did you ever anchor in Eastbourne?—Yes.

2193. In Seaford Bay?—Yes.

2194. If there were a breakwater in Seaford Roads to protect vessels from westerly gales, such as there is in Plymouth Sound, would you anchor under it, or would you prefer a breakwater in Eastbourne Bay, the land protecting you from the west, and the breakwater from the east?—I should prefer Eastbourne.

2195. Should you have any fear in running for Eastbourne Bay of the Sovereign Shoal on the starboard hand, and the Hollowell bank on the larboard, at night or in thick weather?—It would be dangerous.

2196. (Sir *Howard Douglas*.) Would it not be better, then, to have a breakwater in Seaford Bay, and avoid these dangers?—No; I prefer Eastbourne.

2197. (Chairman.) Is not the ground at Eastbourne Bay foul as an anchorage?—It is hard ground; not good holding-ground.

2198. Notwithstanding this, you recommend this as a breakwater harbour?—Yes, because it is shallow water.

2199. (Admiral *Dundas*.) In the event of war, it would be necessary to have a harbour on the coast of Kent, between Beachy Head and the North Foreland, where steamers would be sheltered from all winds and weathers, constantly ready to slip for the protection of the trade and defence of the coast: to combine that object with a harbour of refuge for merchant-ships, at what spot on that coast could you say such a harbour should be constructed?—I should say Dover.

2200. Do you know anything of steamers?—Yes.

2201. Could a powerful steam-vessel get from Dover to Dungeness in a south-west gale?—Yes, I think so.

2202. What are the Shambles composed of?—Shingle; the same as that at the Needles.



Mr. Joseph Read.  
—  
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2203. (Captain *Fisher*.) If a harbour were constructed at Seaford (west of Beachy Head), would you not in thick weather, not knowing where you were, keep out to sea in preference to running for such a harbour, blowing strong from the westward?—I should prefer keeping to sea.

2204. Supposing the same harbour constructed to the eastward of Beachy Head, with the same weather, should you find the same difficulty in running for a harbour there?—I should not run for the harbour if I could not find my position by sounding or some other means.

2205. (Sir *William Symonds*.) What do you think of the holding-ground in Dover Bay?—Good holding-ground.

[*The Witness withdrew.*]

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Weymouth, 29th May, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Mr. R. White.  
—  
29th May, 1844.

Mr. Robert White, examined.

2206. (*Chairman*.) In what situation are you employed?—In the Packet Service

2207. For how long?—From 1806 to 1817, in the “Greyhound” cruizer; since that, commanding a packet. In 1805 I commanded a letter of marque.

2208. Do you consider the anchorage in Portland Roads accessible at all times of night in blowing weather?—At any time.

2209. Do ships coming in at night come between the Race and Shambles, or go to eastward of them?—The passage between the Race and Shambles is not to be taken in all winds; they go to eastward generally.

2210. What do you consider the quality of bottom in Portland Roads?—Blue clay, with about six inches of sand.

2211. In fact, good holding-ground?—It cannot be better.

2212. What is the quality of bottom in Weymouth?—The same; very good.

2213. Do you think much damage has been done to the Roads by heaving over ballast?—No ballast is thrown overboard except close in shore, and the first easterly wind throws it upon the beach, but not to the injury of the Roads.

2214. But there appears no sign of this at present on Portland beach?—The vessels coming there now do not come in ballast; I speak of the billy-boys, flat bottomed.

2215. We have been told by several persons that much injury has been done to the Roads by the heaving over of ballast; is it so?—I think not.

2216. What is the greatest number of vessels you have seen in Portland Roads at one time?—During the war, with a convoy, from 100 to 140.

2217. Did you ever know ships taking refuge here to be caught with an easterly gale?—Yes; ships coming in for shelter from a south-west gale, the wind has suddenly shifted to eastward, but they have laid there then some hours.

2218. Have you known bad consequences?—No; never.

2219. Is the West Bay much used by ships?—No, it is not, except in easterly winds; but on the first indication of a variable wind, they get under weigh.

2220. Have you ever considered the subject of a breakwater at Portland?—Yes; I have been out on both surveys for the purpose, in 1822 and 1836.

2221. Who were the surveyors?—Messrs. Bush and Dodd.

2222. From your experience, which do you consider the best line for a breakwater?—Such as shown on the plan, about a north-easterly direction.

2223. Suppose, then, a breakwater to be thus constructed, would you recommend any opening in it; and if so, should it be close to the shore or in the middle?—I would recommend no opening at all.

2224. Does it blow hard frequently from the north-west?—It does.

2225. Suppose, then, the breakwater to be one continued line, how would a ship in such a wind escape should she part from her anchors?—I think there would be no danger of her parting; but if she did so, she would be able to clear the north-east end.

2226. What is your objection to an opening in shore?—That if a vessel takes that in going out with wind at east, she would not clear the land round Portland.

2227. Would not an opening in the middle obviate this?—Yes; they would by that clear Portland, but at a risk.

2228. Now suppose in a north-west gale, and a ship parting, would not an opening at once and without difficulty afford an escape?—Of course it would.

2229. What is your objection to an opening in the breakwater?—Vessels running in for shelter from a south-east gale would take the north-east part of breakwater, and avoid the end, in preference to taking the opening, as there would be so much cross sea in the opening.

2230. Suppose the 140 sail you have described as taking refuge in a south-west gale be found within the breakwater with wind coming from north-north east, would not the opening mentioned facilitate their getting out?—It would be of use in that case with so much shipping in, but the water would be smooth, and they could then work out with facility.

2231. (Sir *Howard Douglas*.) Do you think such a harbour would be much frequented by the trade for shelter in peace, as well as protection in war?—Decidedly so. I have found many vessels in an easterly gale who would not come in to Portland, there being no breakwater.

2232. (Admiral *Dundas*.) Is there much trade in stone and fishing in Portland?—There is no other trade.



2233. Would it be a convenience to such trade to have a small opening of 150 feet from Portland to the south end of the proposed breakwater?—I should think not.

Mr. R. White.

2234. In war could a fleet of men-of-war and steamers keep their station off Portland as the bays of Weymouth and Portland now can, or would a breakwater in the entrance ensure their effecting that service in all winds and weathers?—They could not, supposing the wind at south-east; but if there was a breakwater, they would be able to get under weigh, and proceed at any time, as sailing vessels, with the wind at south-east, sheltered by the breakwater, would be enabled to get under weigh, let the weather be what it will; and by making a board to the north, would be able to round the breakwater, and proceed round Portland, with a flowing sheet.

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2235. Inside or outside the Shambles?—Inside with ebb, and I think they would be able to go to eastward with flood.

2236. Night and day?—Yes; if they could see the land or lights.

2237. Would a passage of 150 feet at south end of intended breakwater bring in any sea?—With wind at south-east, a great deal of sea.

2238. (Captain *Fisher*.) Your answers have all been given with the understanding that it was in such weather that a ship could turn in?—They were.

2239. Would not such an inner opening as referred to before enable vessels bound to the westward to leave this harbour in strong north-east winds, and make their passage round Portland and down Channel, when they could not work out of north-east entrance?—They would be able to run through such an opening with wind at north-east, but they would not be able to get their anchors; they must either cut or slip.

2240. Could ships in strong westerly gales fetch the harbour from the east end of the Shambles?—Yes; in any tide.

2241. Would it be necessary, in your opinion, to have a floating light placed on some part of the Shambles for the better direction of ships seeking this harbour in thick weather and by night?—I do not think it necessary.

2242. What mark have you for clearing the east end of Shambles by night?—I should run to the eastward with the Upper Portland Light open to westward of the Lower Light, until I got the north part of Portland to bear north-north-west, or the lights to bear west-north-west. I should there haul in.

2243. With the light bearing west-north-west and not knowing your exact distance, would it be safe, under all circumstances, to haul dead in to the northward?—Not in thick and dark weather, but I should make sure of my eastward by the distance run.

2244. Under such circumstances do you consider a floating light on the Shambles would not be a great additional security and direction for large ships?—No, I do not.

2245. (Sir *Henry Pelly*.) You understand that there would be a light on the breakwater?—Of course.

2246. (Captain *Fisher*.) At what distance would the breakwater light be from the east of the Shambles?—About seven or eight miles, and Portland Light about the same.

2247. (Sir *William Symonds*.) Do you consider that a distance of two miles from the north-east end of the proposed breakwater, to the west of the Bay, would be sufficient for men of war and all kinds of merchant-men to work out and round it with the wind off the land?—Yes; but two-and-a-half miles would be better, as it would rest on the wreck of the “Abergavenny,” and the Bay will then be left clear of all wreck and danger.

2248. Suppose wind from east-south-east to east-and-by-north, and a heavy laden merchant-vessel, many of which are ill-manned and unmanageable, fetches out of the inner or middle proposed entrances to breakwater, with an ebb tide, would she find embarrassment from the Race besides the coast of Portland; and would it not be very important to go out to north-east of the breakwater in order to fetch to eastward of Race, if they had not confidence or knowledge of the passage near the Bill?—In the first place, such a heavy vessel could not clear Portland, even with a weather tide; but if she went to the northward of breakwater, she could clear the land well.

2249. Would not such openings in the breakwater subject vessels within it to wind and sea in heavy gales, and therefore to insecurity?—I should think so.

2250. (Chairman.) Supposing a passage 600 feet wide?—Certainly; I think so, with such an opening.

2251. (Mr. *Walker*.) How do you water the boilers of your steamers?—We use salt water.

2252. Is there plenty of water on Portland?—From my own knowledge I cannot say, but I have heard from engineers there is a great deal. At Mill Cove, on the north of Weymouth, there is a plentiful supply.

2253. You have stated there is about six inches of sand over clay in the Roads?—Yes; about that.

2254. Does this increase or decrease?—I should say not.

2255. Is it your opinion that if Portland Roads were closed in by a breakwater, that there would be any tendency to tilt up?—I should say not, as there is at present little or no tide.

2256. But is there not considerable silting up in Weymouth Harbour?—Not at all; the back-water keeps it clear.

2257. Has it not been dredged out occasionally, to maintain the present depth?—It has, since the last Commission was here, and two-and-a-half feet gained.

2258. Was that an accumulation from silt, or solid?—It was solid clay, and that depth was given and not recovered.

2259. Has not that silted up partially since?—No, it has not.

2260. Has the back-water silted up?—No; it scours out.



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2261. You named that you know cases of sudden shifts of wind from south-west to east, when ships have remained several hours after a change of wind; could they have got out had they chosen to do so?—Yes; I should think so.

2262. To what winds do you consider the Roads at present exposed?—From east to south.

2263. (*Chairman.*) How long is it since the dredging took place?—About three years.

2264. And you have a dredging vessel?—Yes, a steam dredge.

2265. Have not some embankments been made within a few years to keep out the water?—Not to keep out the water, but to make land for building.

2266. You mean that buildings now stand where water formerly lay?—Part of the back-water has been enclosed to make building land; I should say about 150 acres.

2267. Was it a space over which the tide flowed?—Yes.

2268. Who are the proprietors?—There are several.

2269. Do you know if the authorities were consulted in this?—The town council sold it for building.

2270. Do you know if any reference was made to the Admiralty before it was done?—Not to my knowledge.

2271. Have you any property there yourself?—None.

2272. (*Sir Howard Douglas.*) Has this improved the harbour?—I do not consider that it had any effect either way.

2273. (*Chairman.*) Were you here when the “Abergavenny” was lost?—Yes.

2274. Was she coming in for Portland Roads when she struck?—Yes. It was in the evening, about dark.

2275. Were other ships with her?—Yes, three others had gained the Roads.

2276. Had she a pilot on board?—She had a fisherman, but not a pilot. I think that had there been a breakwater she might have been saved, as they would have run in during the early part of the day.

2277. Would this wreck be in the way if a breakwater were made here?—Only in the way of an anchor. There is  $9\frac{1}{2}$  fathom over her. A buoy would be in the way.

2278. Have you ever heard of a prospect for cutting through the Chesil Bank?—Never.

2279. (*Captain Washington.*) Do you think if a cut were made, as has been proposed, through the Chesil Bank, that it could be kept clear of shingle on the west?—Never. I think the first moderate gale would fill it up.

2280. Do you understand that the water upon the east is higher than on the west side of the beach by about 18 inches on ebb, and the reverse on the flood?—I have heard it was higher on the west both on flood and ebb.

2281. Do you think if an opening were made there that the strength of tide would keep it clear?—No.

2282. Where do the wrecks in the West Bay generally take place?—About Wyke.

2283. Suppose a passage could be kept open through the Chesil Bank a quarter of a mile wide, might it not save vessels from going on the beach?—I think at such a time that there would be so much sea that it could not be attempted; they would not see it.

2284. By removing the obstacle which causes the sea, viz., the bank, would not a great deal of the heavy sea be avoided?—I should think not.

2285. (*Sir Henry Pelly.*) Would not such an opening injure the Roads?—It would probably destroy them and Weymouth also; town and Roads both.

2286. (*Lieut.-Colonel Colquhoun.*) What is the motion of the shingle on Chesil Beach?—It heaves up, and does not travel either east or west; west and south-west gales heave it up.

2287. What is the nature of the shingle?—It is largest near Portland, and gradually decreases in size as it goes westward, and opposite Bridport it is reduced to sand. Portland stops the shingle completely; it does not go beyond the village of Chesil. There is no shingle in the anchorage.

[*The Witness withdrew.*]

Mr. Edward Allen.

Mr. Edward Allen, examined.

2288. (*Chairman.*) Where do you reside?—At Portland.

2289. What is your occupation?—I am a part ship-owner.

2290. In what trade?—In the Irish Channel and Straits.

2291. Have you been much accustomed to Portland?—Until about 26 years of age, and then to the Irish trade. I was a branch pilot for this Port when a young man.

2292. Should you have any difficulty in bringing a large ship into Portland Roads in night time?—None.

2293. Would you bring her in between the Shambles or round to the eastward of them?—It would depend on the state of wind and tide.

2294. Do the trade of the Channel in south-west gales take shelter here much?—Yes, from 50 to 100 at a time.

2295. Have you ever seen ships riding in Portland Roads with a heavy gale from the eastward?—Yes.

2296. Have you ever known them drive ashore with the wind at eastward?—Yes, several instances.

2297. Were any lost?—They have been obliged to discharge their cargo to get them off.

2298. Do you think if there were a breakwater here it would be much resorted to as a harbour of refuge?—I think many ships would come under a breakwater here when they



could not gain Portsmouth, instead of bearing up for Plymouth. Dartmouth is not a place fit for a heavy ship. Mr. *Edward Allen*.

2299. Do vessels coming in to Portland Roads get heavy gusts off the land from south-west?—They do, close in.

2300. How far should you keep off to avoid it?—About a quarter of a mile.

2301. Have you much considered a breakwater here?—I have considered long that a breakwater here would be a very desirable thing for shipping passing both up and down Channel.

2302. Looking at the place of a proposed breakwater, would it be desirable to have an opening in it, and, if so, would you have it in the middle or at the south or inner end?—I would have no opening at all.

2303. State your objection to an opening in the middle?—In the first place, the tide would set so much round the opening, there would be much difficulty in vessels working out in strong easterly winds; and next, an opening would let in such a sea that vessels could not lie with such safety as they would were there none.

2304. Do you think if the opening were only 600 feet that this would be the case?—Yes, I do; it would be more difficult for heavy ships getting their anchors lying under the breakwater.

2305. You speak of ships working out, but the opening is not made with that intention, as, in easterly winds, there is the outer end of the breakwater to get round?—I consider that if there were no middle opening the water would be so smooth that a large ship might get up her anchor and work out with the wind from the east, round the east end of the breakwater, and and thence clear the east end of the Shambles.

2306. Now supposing an inner opening only 200 feet from the two-fathom edge, what are your objections?—It would expose all vessels lying in six-fathom water to a south-east to south-south-east wind.

2307. There is a large quantity of stone lying on the Crown property in Portland, have the inhabitants any privilege to consider that as refuse stone, and their property?—The refuse that lies in the Queen's ground is her property, and neither the islanders nor other people have any claim to it.

2308. (*Sir Howard Douglas*.) Do you consider that if such a harbour as proposed were constructed, that it would be much resorted to by the trade for shelter in peace and protection in war?—Both for ships bound up and down Channel, as, if the wind were from the eastward, they could get under weigh and go to sea, whereas they could not do so now.

2309. You have said that vessels in strong easterly gales, if a breakwater existed, would resort to this in preference to Plymouth; would they prefer it to West Bay?—Certainly.

2310. Why?—Because, should the wind fly to westward, there would be difficulty in getting out of the West Bay.

2311. (*Admiral Dundas*.) In war time, would a breakwater enable men-of-war and steamers to keep their stations off here in all winds and weathers, which, under present circumstances, they cannot do?—Yes, it would.

2312. There is a good deal of trade here in stone and fishing, do not you think it would add to the commerce of that trade to have a passage at the south end of the breakwater, between it and the shore?—No; I consider it would be a great inconvenience.

2313. Do you know much of Beachy Head?—Yes, for many years.

2314. Which side of Beachy Head would you construct a harbour to protect merchant-vessels, and enable men-of-war and steamers to keep that station in war time?—On the east.

2315. Do you know the nature of the holding-ground in the East Bay?—Good clay bottom in Bourne Roads.

2316. Have you ever anchored there?—I have, but have not sounded.

2317. Is there any danger in running in there at night between the Royal Sovereign and the Holywell Bank in a large ship?—None, if there were directing lights.

2318. Were you ever in Seaford Roads; what is the holding-grounds?—Good.

2319. Suppose a breakwater, such at Plymouth, formed in Seaford Bay, would you, with a strong westerly, bound down Channel, seek shelter under such a breakwater, or would you run to the eastward of the Head and anchor in Eastbourne Road?—I should prefer the breakwater.

2320. But supposing there were breakwaters in both Bays?—I should take Bourne Roads.

2321. Do you apprehend any danger in running into Seaford Bay with a breakwater?—At night I might not get under the breakwater cleverly, my canvass not being sufficient; but if running for Bourne Roads, and I could not make my object in getting in, I should have the Downs under my lee to run for.

2322. (*Sir Henry Pelly*.) Now suppose an easterly wind, which would you prefer?—I should then prefer the West Bay.

2323. (*Admiral Dundas*.) In the event of war it would be necessary to have a harbour between Beachy Head and the North Foreland, where would you construct a harbour accessible at all times of tide and in all weathers for the benefit of the trade and for men-of-war?—I should say Dungeness.

2324. Why do you prefer Dungeness to Dover?—In consequence of the cross tides at Dungeness.

2325. What is the nature of the holding-ground in Dover Bay?—Very good, as good as under the Ness.

3326. Suppose Dover Bay, encircled by a breakwater of two or three miles in extent, would the tides affect ships as much then as you apprehend they would now?—No, of course not.

2327. (*Sir Henry Pelly*.) Why do you give the preference to Dungeness over the Downs for a harbour?—Dungeness affords a better outlet for the westward.



Mr. Edward Allen.  
—  
29th May, 1844.

2328. (Captain *Fisher*.) How long have you been a pilot for this port, and do you consider yourself to have a perfect knowledge of it?—For 12 years for this port; and I consider my knowledge of it good.

2329. As regards the passage in the south-west end of the proposed breakwater, would or would not such an opening in your opinion enable vessels bound to the westward, with the wind strong from the north-east, to leave the harbour with greater facility and make their reach round the island of Portland than if there were but one entrance to north-east?—I should say, yes.

2330. Would they not be able to sail through that passage with the wind at north-east in such weather when vessels could not work from the anchorage round the north end?—If blowing so strong that she could not beat round the north; and it would of course be easier to go out of a south opening.

2331. Ships running for this harbour in strong gales from the west, would they fetch the north end from east end of Shambles?—They would with ebb, but not with flood tide.

2332. Would it be necessary or desirable, in your opinion, to have a floating light placed on some part of the Shambles for the better direction of ships seeking the harbour on dark nights and thick weather?—I should say it would be desirable, but difficult to keep it there.

2333. Have you any night-mark for telling you when you are to the eastward of the Shambles?—Not at night.

2334. (Sir *Henry Pelly*.) Would not a light on the breakwater answer the purpose?—Certainly it would.

2335. What would be the distance of a light on breakwater from the outer end of the Shambles?—about four miles and a quarter.

2336. (Sir *William Symonds*.) What is the mark for anchoring in Dover Bay?—I know of no particular mark.

2337. Do you know how far the good ground extends off Dover?—I do not.

2338. Do you consider it equal in extent to good ground at Dungeness?—I do not.

2339. Is not the wind truer when there is low land like that of Dungeness than in the neighbourhood of high land?—Yes.

2340. You say you are an old coaster, would you run for a port inside the Shoals, called the Royal Sovereign, the Horse of Willingdon, the Boulder Bank, and others, in thick weather, or dark nights, knowing from every chart of the Channel that there are foul spots in all parts of the Bay between Dungeness and Beachy Head, excepting Bourne Roads?—I would not.

[*The Witness withdrew.*]

Captain  
C. A. Manning.

Captain C. A. Manning, Vice-Lieutenant of Portland, a magistrate, and Deputy-Lieutenant of the County, examined.

2341. (*Chairman*.) How long have you resided here?—For 27 years.

2342. Does your acquaintance with Portland give you frequent opportunities of becoming acquainted with the anchorage?—It does.

2343. What is the greatest number of vessels you have seen at one time in the Roads?—I think, 110 at one time.

2344. Do you know any instance of ships being caught in this anchorage in an easterly gale?—I have.

2345. And do you know any case of vessels being driven ashore for want of a protecting breakwater?—Yes, several, particularly in last February twelvemonth. In one case, a brig, the “*Astrea*,” bound to the Mediterranean with Government stores; she had five anchors ahead, and was driven ashore. There were five other wrecks also.

2346. How many at different times ashore?—Nearly 30 in the East Bay.

2347. Is Portland much frequented by vessels in south-west or westerly winds?—Yes, frequently 80 or 90; from 30 to 40 being about a general number.

2348. Have you been much used to the sea?—In yacht and boat-sailing a good deal.

2349. Has it come under your observation that the stone-vessels throw their ballast over?—Yes; and I was particularly requested to bring it to the notice of the Commission.

2350. Is it an injury to the roadstead of Portland?—Not the main roadstead; but within about a quarter of a mile from shore the approach is much injured.

2351. We have been told that vessels come very generally without ballast?—Some, the billy-boys, do so; but all that come with ballast throw it over.

2352. Is there any person, harbour-master, or other, who has a jurisdiction over this?—I do not think that the harbour-master of Weymouth has power over Portland.

2353. But you, as a magistrate, have been applied to to represent the matter to the Commission?—I have.

2354. Do you know the extent of the Crown property in Portland?—The absolute property is 282 acres 1 rood; but the power of the Crown gives a complete control over the waste, being a Royal manor.

2355. There is an immense quantity of the cap and roche stone on the waste and other parts; have the people on the island any right to this waste stone?—None whatever; where on Crown property, it belongs to the Crown.

2356. Is the stone we see about of a hard quality?—Yes, particularly under water.

2357. This stone is not much in request?—No, on account of not being good for ornamental purposes, there being so much shell in it.



2358. Is there a plentiful supply of water on the island?—Plenty; and of good quality.

2359. Does any lie within the proposed breakwater?—Yes.

2360. (Mr. *Walker*.) Is it spring-water?—It is.

2361. Whence do you suppose it derived, from rain collected on the island?—I should say from other sources; but do not feel prepared to go into the subject.

[*The Witness withdrew.*]

Captain  
*C. A. Manning.*  
29th May, 1844.

Mr. *Thomas Hitt Harvey*, examined.

Mr. *T. Hitt Harvey*.

2362. (*Chairman*.) Are you residing at Weymouth?—Yes.

2363. In what capacity?—As land-surveyor and clerk to the Weymouth Union.

2364. Have you given much attention to the subject of breakwaters?—Constantly from the year 1812, when I assisted my late father in all his plans.

2365. Will you have the goodness briefly to state your plan of a breakwater?—My views for a breakwater for Portland is that it should start from the Nose, or north end of the island, 60 chains south-east of the Castle, extending into the sea about  $2\frac{1}{2}$  statute miles, in a north-east direction, terminating on the wreck of the “*Abergavenny*.”

2366. How do you propose building it?—By forming two lines, one for the outer base, the other for the inner, and filling in between.

2367. What stone do you purpose using?—That of the place.

2368. What do you suppose the expense would be?—600,000*l.*, according to a detailed estimate.

2369. (Mr. *Walker*.) In what time do you think it might be completed?—In six or seven years.

2370. Do you, in your estimate, include anything to be paid for the lordship of the stone?—No.

2371. Do you purpose using the cap and roche stone only?—The cap stone for the breakwater up to low-water mark, and the roche from low water upwards.

2372. Do you consider it necessary to have that extent of breakwater, or is it only for the purpose of reaching the wreck of the “*Abergavenny*”?—I consider it necessary to reach the “*Abergavenny*” for two reasons, first, that the tide is scarcely felt at that spot; and, secondly, as a protection to Weymouth Harbour and esplanade in south-east gales.

2373. Suppose a breakwater to give entire protection to Portland Road only, how far would you carry it out?—I do not consider it should be shorter than I before stated.

2374. In constructing a breakwater, do you consider it would be desirable to have an opening 600 feet wide, not for working out, but for going out freely?—I do not, as it would interfere with the safety of the roadstead.

2375. How?—By creating a tide and a deposit; also as being dangerous with wind at south-east, to vessels entering, to strangers especially.

2376. What is the rate of tide within the Roads?—Very trifling,  $1\frac{1}{2}$  or 2 miles.

2377. How will the opening create a tide?—As the back-water from the East and West Fleet is drawn off every tide, it would make its exit by the opening as being the nearest point rather than by going round the north-east end.

2378. (Admiral *Dundas*.) If in the intended breakwater a second entrance were determined on, where would you advise it to be placed as most convenient for all vessels, particularly for the stone and fishing trade?—The nearer the shore the safer for small vessels.

2379. Would it not be worth trying to leave a passage open to the south at first, and if found detrimental to the harbour, it might be easily filled up?—I do not think it would be advisable to have an opening, but there would be no harm in trying it, as you propose.

[*The Witness withdrew.*]

Mr. *John Jerrard*, examined.

Mr. *John Jerrard*.

2380. (*Chairman*.) Are you harbour-master?—Yes.

2381. Have you any control over the anchorage in Portland?—None whatever.

2382. Has the water in Weymouth Harbour diminished?—Never in my recollection.

2383. What quantity of land has been taken in from the back-water?—I cannot say; perhaps 30 acres or more.

2384. By whom are you appointed?—First, by the corporation, and latterly by the town council.

2385. (Mr. *Walker*.) What depth of water at high-water spring-tides was there formerly over the lands now enclosed?—About 3 or 4 feet on the outer part, near the lake.

2386. Was there any question at the time as to this enclosure lessening the back-water, and thereby injuring the harbour?—No.

2387. Do you not consider that the capability of your harbour depends on the back-water?—No.

2388. Then on what does it depend?—We have no shifting sands; the tide keeps it clear; the ground is hard blue clay.

2389. Suppose an embankment formed above, and all the back-water removed, would it not improve the harbour?—Supposing that case, it might.

2390. (Admiral *Dundas*.) Has the harbour improved since the enclosure of the 30 acres you mention?—Yes.



Mr. John Jerrard.  
29th May, 1844.

2391. Is it from such enclosure or from dredging that the harbour has improved?—From the dredging.

2392. Has the enclosure been detrimental?—Not at all.

2393. Have you turned your attention to the subject of a breakwater in Portland Roads? I have.

2394. State where you would put a second entrance, the first being round the east end, to give facility to the trade, especially stone and fishing vessels?—I consider that an opening would be very necessary; and it should be between Portland and the breakwater.

2395. (*Chairman.*) Is it considered that the corporation have a right to enclose any portion of the backwater?—We have always considered so.

2396. (*Captain Fisher.*) Are you a seaman by profession?—Yes; but have not been at sea for 30 years.

2397. Have you a general knowledge of this port and its entrances?—I have.

2398. Do you consider that ships seeking shelter in a harbour constructed in Portland Roads—seeking shelter in strong westerly gales—would in general come in between the Shambles and Portland?—Yes, they would.

2399. Do you consider that it would be necessary or desirable to have a floating light on some part of the Shambles, for the better direction of ships seeking shelter in this proposed harbour at night or in thick weather?—It would be very desirable as a guide for ships coming into the harbour.

2400. (*Mr. Walker.*) Was not the ground that was reclaimed sold by the corporation for building?—It was.

2401. Were not some of the corporation purchasers of this land?—Yes; some two or three.

[*The Witness withdrew.*]

Capt. C. F. Payne,  
R. N.

Captain Charles Frederick Payne, R.N., examined.

2402. (*Chairman.*) How long have you been resident here?—All my life, except when at sea.

2403. Have you ever been professionally employed here?—Only two days in a sloop-of-war.

2404. Has your consideration been turned towards a breakwater in Portland Roads?—Not much.

2405. Do you know of any vessels having driven out of Portland Roads in south-west gales?—Yes, several; and in the gale of 1824, from S.S.E. to south, several vessels were driven on the north shore at Osmington, and wrecked.

2406. Supposing a breakwater to be carried out a length of two miles, and vessels parted in a heavy gale, would there be any risk of their foundering on the breakwater?—Yes, very great risk.

2407. (*Sir Howard Douglas.*) You would consider it advantageous to construct a harbour of refuge here?—Certainly, and that it would be greatly resorted to.

2408. Do you think it essential that there should be a southern opening to the breakwater?—Yes, I do; in case of the wind chopping round to the north or north-east.

2409. (*Sir William Symonds.*) Is your experience derived from actual experience in using Portland Roads, or is it merely a matter of opinion?—It is a matter of personal observation.

2410. How long is it since you have been in actual service on the coasts of the Channel?—Thirty years; but during that time I have sailed about in cutters and boats in Portland Bay.

2411. Have you been out in these boats night and day, winter and summer?—No; only in the day-time, occasionally in winter and summer.

[*The Witness withdrew.*]

## HARWICH.

Thursday, June 6th, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Mr. Isaac Saxby.  
6th June, 1844.

Mr. Isaac Saxby, examined.

2412. (*Chairman.*) What vessel do you command?—The revenue cruizer, "Scout."

2413. How long have you been on this station?—Between 16 and 17 years.

2414. You have been afloat all the time?—I have.

2415. What change has taken place in the channels within your remembrance?—The point of Landguard Beach has grown very much to the westward, and choked up the old channel.

2416. How do you account for that?—It is in consequence of the cliff at Blackman's Head being washed away.

2417. In what manner do you account for the washing away the cliff having had that effect?—I think in consequence of the cliff wearing away an effect has been produced on the current.

2418. How has that affected the point on the opposite side?—It has thrown the water on the other side; the force of the water strikes on the other side, and causes the point to come out; if the land was to wash away half a mile, the other would follow it.



2419. In what degree is the land at Blackman's Head washed away?—I should think pretty well a quarter of a mile.

2420. Did the cement stone, which has been said to be removed, form any sort of barrier round the foot of the cliff?—Yes, in those days it did; when I first came here the cliff did not wash away nearly so fast as it has done latterly; I think the removal of that has been one cause.

2421. To what height did that stone stand so as to form a barrier?—In some places three or four feet high on Blackman's Head.

2422. Now it has been entirely removed?—Yes, it is taken away altogether.

2423. Is the removal still going on?—Yes.

2424. Are the tides more feeble than they were?—Yes, they run at a less rate; thousands of tons have been taken away opposite my house, which causes the sea to come in and wash the land there. I have repeatedly stated what would be the case, that Harwich would wash down if they kept undermining the land.

2425. What alterations have taken place in the channels?—When I first came to Harwich, about 16 years ago, the best entrance into Harwich was with the lights a little open to the eastward; but now you must have them a long way open to the westward.

2426. Do you mean one light opening of the other?—Yes; the high light opening to the eastward in former years, now its breadth must open to the westward.

2427. You mean to say that the water did not wash the foot of the cliffs so much before the stone was removed?—No, it did not; the stones acted as a breakwater to it.

2428. Is there any other part of the harbour or neighbourhood from whence stone is removed?—All the way round in the bay.

2429. Did you ever hear of any mischief being attributed to its being removed from other parts?—Yes; the land is falling away at the back of Dover-court, close at the back of my house; there have been fields washed away in the Bay to the westward of Blackman's Head.

2430. Whose property was that?—I do not know.

2431. It was not the property of the Government?—Not that I know. I think some of it belonged to Mr. Pattick; he has had a whole field washed away within my remembrance.

2432. Has the wasting away of the cliff, on that side, been as great as it is here?—I think it is quite as great.

2433. Does your experience enable you to suggest any remedy for the evil you have presented?—If there was a breakwater off Blackman's Head, that would force the water over to the eastward, and drive the point of the beach away again.

2434. You mean that it would drive Landguard Point away?—Yes.

2435. What advantage do you expect from driving Landguard Point away?—I think there would be more water in the harbour.

2436. Why?—The beach will sometimes wash in a little.

2437. Do you think that Landguard Point, stretching out as it now does, forms a protection to the harbour from the sea?—Yes; it forms a very good protection in that bay when the wind is southerly.

2438. You would take away that point?—I would diminish it. I think you could find more water there. On this side it is rocks, and on the other side it is shingles, which is borrowed from the sea; it is much more easily driven away.

2439. Have you ever heard the pilots complain of inconvenience from the state of the harbour?—They have complained about the Point.

2440. They have complained in conversation?—Yes.

2441. They have complained of it as tending to narrow the channel?—Yes, it is much narrower than it was in former years; there is the best water close along the beach.

2442. What is the shoal which is most inconvenient in entering the harbour?—The Altar Bank has been most in the way.

2443. Is that diminishing in size?—Yes, in former years there was not above five feet water over it.

2444. From what cause do you suppose it has diminished?—They have taken a great quantity of stone off it.

2445. Did you ever hear of any complaint of the taking of stone from any other place than the Blackman's Head?—I have heard Mr. Pattick complain very much of the taking away of the stone from the back of his fields; he had made a barrier to keep the sea off, but now it is taken away; the moment the cliff falls down, there are people constantly employed in digging out the cement-stone; thousands of tons are dug up.

2446. Do you suppose it to be the greater spread of water from the taking away the stone from the Ordnance premises which causes this inconvenience?—Yes.

2447. Did not the water reach above the barrier you speak of formerly?—At high water it did.

2448. At high water the foot of the cliff was washed formerly?—Yes.

2449. Was not the cliff carried away before they began to carry away the stone?—It was a little, but not so much.

2450. There was a decay of the cliff, but not to the same extent?—Yes.

2451. The whole object you had in view in running out a breakwater, is to act on the beach in Landguard Point?—Yes.

2452. Supposing the whole frontage were enclosed down to low-water mark, would that be better or not than the running out a breakwater?—No, I should think that the breakwater would be best.

Mr. Isaac Saxby.

6th June, 1844.



Mr. Isaac Sarby.

6th June, 1844.

2453. Would not that measure restore the loss of the stone which had been taken away?—It must be thrown a long way out, for there has been a great deal taken away.

2454. Would not that give a fairer line to enter than throwing it over in the other direction?—The running a pier out, it would send it over with greater force.

2455. Is there much sea comes into the harbour at Harwich with the wind blowing in?—Not so much as might be expected; the shoals break it outside after you have just run clear of the Altar.

2456. It is no part of your idea that the breakwater is to give a protection to the harbour, but merely for the run of the tide?—It will break off the sea in a S.S.W. wind.

2457. Your idea is merely to have a breakwater for the effect on the Point?—And for the protection of the harbour also.

2458. To what degree has it been an inconvenience to the anchorage when the sea sets in?—A ship may ride here at any time; the worst winds that blow are the winds from the north-west, and W.N.W.; they blow right down Manningtree River.

2459. When you say the west wind or the W.N.W., you are going from the sea entrances up to the anchorage inside?—Yes.

2460. Where do they feel the north-west wind most?—In Manningtree River, the Stour.

2461. There are three old men-of-war sunk off the Ship-yard, have you ever heard any complaint on the part of pilots or the people of the place of those ships being there?—I have heard them say that it would be much better if there was a breakwater to lay the vessels alongside, and to protect the vessels in a wind.

2462. Have you heard any complaint of those vessels lying there as affecting the tide?—No, there have been various opinions about it; one opinion has been that that has driven the shingle round towards the Dock-yard in gales of wind from the north-west; sometimes it will drive the beach considerably away.

2463. Did not the tide run stronger there before than it does now?—I do not know, they have been laid there all the time I have been in Harwich.

2464. What is the greatest number of ships you have ever known here?—I think I have seen 500 or 600 vessels of different descriptions here at one time.

2465. Coming in here for refuge?—Yes.

2466. What is the largest ship you have ever seen here?—I have seen ships of 60 or 700 tons.

2467. Have you ever seen any men-of-war here?—No, no larger than sloops-of-war; I have seen them here.

2468. Have the pilots any difficulty in bringing in the vessels at night?—No, not at all, when the weather is clear.

2469. What is your apprehension of the consequences, if the breakwater should not be run out in the manner you describe?—I think the Point at Landguard will still extend away to the westward and choke the entrance of the harbour up so much that there will not be water for any large vessel to come in at low water.

2470. A great many vessels, when they do not come in, anchor in the Rolling and Pitching ground outside?—Yes, that is according to how the wind is.

2471. Where are they?—The Rolling ground is just outside of Landguard Beach, to the southward; the Pitching ground is to the eastward of Landguard Point.

2472. (*Sir Howard Douglas.*) Is the bank, called the Guard or Harwich Shelf increasing?—No, I do not think it is increasing; it is all a dead flat; there is no navigation upon it.

2473. Have you reason to believe that that is extending outwards?—I think it has accumulated to the eastward.

2474. If you know that it has from any mark or sounding, have the goodness to state it?—No; I only go by the marks over yonder; we have to go further eastward to the West Channel to enter.

2475. Is the Glutton Shoal increasing?—No, I do not think it is; in former days there used to be less water on it than there is now.

2476. Is it a deposit?—It is clay, and a few stones intermixed along with it; it might be removed.

2477. Is that deposited by the current?—I think it is by the tide setting round.

2478. You know what is meant by deposit?—Yes, that it is collected there itself by the set of the tide.

2479. Do you know the Altar Flat?—Yes, that was cement, stone, and clay.

2480. What is the state of it now?—It is diminishing fast, in consequence of its being taken away.

2481. Is that from a deposit?—No, that has been there ever since I have known Harwich.

2482. What do you consider the elongation of Landguard Point to be occasioned by?—The tide setting round to the eastward; it causes an eddy tide.

2483. The flood-tide sets from the eastward?—Yes.

2484. It is clear to you that the eddy of those two currents occasions the elongation of the Point?—Yes.

2485. You think that a breakwater from Beacon Cliff would have the effect of changing the current?—Yes.

2486. Do you think that the action of the current, which would be caused by the construction of the breakwater, would be produced on the ebb-tide or the flood-tide?—By the ebb-tide.



2487. Will not the ebb-tide operating on this breakwater have passed the Point during that action of the ebb; how do you think it will operate?—In consequence of the breakwater we have here, it will cause a very strong ebb-tide, and force it away.

2488. Would it be more likely to produce that effect if the breakwater were placed higher up?—Anywhere along here from Blackman's Head towards the Lighthouse would answer the purpose.

2489. On consideration, do you not think, so far as the effect is produced by deflecting the current from the west side, it would be likely to be more efficacious if the breakwater were higher up?—Within Blackman's Head and the Low Lighthouse would answer the end.

2490. (*Chairman.*) What would be the effect of this breakwater from the Beacon Cliff on the channel of the river during flood-tide; would it not increase the eddy?—No, I think the tide would set right in.

2491. Is the western channel to the harbour of Harwich shallowing and narrowing, or deepening and extending?—I think there is as much water there as there ever was; there is a channel called the western channel, but it is not a navigation for large ships; only very small vessels come through that channel, it works further to the eastward; but I think there is as much water on it as ever there was; the banks are washing out to the eastward and becoming narrower.

2492. Is the bank to the southward of the Cliff Rock diminishing?—Yes, they are working it away; it is a dead flat along there.

2493. Has everybody a right to take the cement-stone?—No, it belongs to certain merchants; they pay so much to collect and dig it up.

2494. To whom do they pay for the privilege of collecting it?—I do not know.

2495. What do you think would be the effect of reclaiming as much as possible of the bank to the southward of the town, between the town and Blackman's Head?—We might have a good way there for embarking or disembarking troops at high water; ships might lie along side for taking in troops, but they must go off again.

2496. Would not the effect of reclaiming a large quantity of this bank, the Harwich Shelf, be the throwing the current more to the eastward side of the river, and consequently improve not only the main channel but the west channel also?—Yes.

2497. (*Adm. Dundas.*) Have you ever known a ship drag her anchor in Harwich Harbour?—Many.

2498. Is the holding-ground bad?—No, but they do not give them cable enough; it is through neglect.

2499. Is the holding-ground good or bad?—Good.

2500. Would all the alterations you have proposed make Harwich such a harbour that vessels could enter and leave the port at all times of tide, wind, and weather; night and day?—At any time; ships drawing not more than 18 feet water could come in at any time of the tide if they could sail in, and were acquainted with the deep-water channel, which is but narrow.

2501. What sort of holding-grounds is there at Hollesley Bay?—Very good.

2502. Did you ever know a ship drag her anchor there?—No.

2503. What is the worst wind there?—I think the wind at east or E.N.E.; with the wind southerly, the Whiting Shoal protects it.

2504. What distance is it from the end of the Whiting to the shore?—About a mile.

2505. What sort of ground is there upon the north of the shoal?—Beach, and very steep beach.

2506. If a ship goes well up in the bay, she is protected by the shoal?—Yes.

2507. You consider Hollesley Bay very good anchorage?—Yes; I have rode there many times, and I have thought myself safe.

2508. In what depth of water?—Five fathoms water.

2509. With what bottom?—Clay and sand.

2510. (*Sir Howard Douglas.*) Do they take away the stone at Blackman's Head immediately from under the cliff, or are they limited to a certain distance from the cliff?—Close under the cliff.

2511. Do you mean on the Ordnance land?—Yes, I have seen it taken away from the Ordnance land in boats.

2512. Are they not limited to 50 yards off?—I have seen the boats lying close against the cliff, but that is a business I have never troubled my head with.

2513. They might have the vessels close alongside the cliff, but not take the stone from thence?—I have seen them loading the boats there when I have been out in the galley close under the shore.

2514. (*Capt. Fisher.*) Where, in your opinion, would be the best place to establish an asylum harbour on this coast, anywhere between Orfordness and the North Foreland, accessible at all times of the tide for men-of-war, armed steamers, and merchant ships of the largest class?—I should say Harwich.

2515. Does Harwich afford the means of a supply of water, fuel, and other necessities which may be required for such a squadron?—There is plenty of fresh water at Shotley and Erwarton, thousands of tons are running away daily, they might get plenty of fuel here; and there might be plenty of provisions of all kinds procured from the country round at any time.

2516. Have you observed, or do you know that Harwich is much frequented by ships approaching to or leaving the Thames in bad weather, or meeting with contrary winds?—It is the only place of refuge for them at present.

Mr. Isaac Saxby.

6th June, 1844.



Mr. Isaac Saxby.  
 ———  
 6th June, 1844.

2517. Can ships-of-war and merchant-ships of the description mentioned at present approach Harwich through all the channels, through Hollesley Bay at all times of the tide?—Yes.

2518. The general anchoring-ground you say in the harbour is very good?—Yes.

2519. (*Sir Howard Douglas.*) Where is the quarter of a mile you describe as having been washed away?—To the westward of Blackman's Head.

2520. Has any been washed away from the Head itself?—Yes, a great deal.

2521. How much from Blackman's Head eastward?—I cannot rightly say.

2522. One hundred yards?—Yes, there may have been.

2523. So that the washing away you refer to is what has formed the bay to the westward of Blackman's Head?—Yes.

2524. If only a hundred yards has been removed from the space to the eastward of Blackman's Head, do you not consider that that would be what would regulate the extension of Landguard Point, more than the washing away in the bay to the westward of the Point?—I am not quite sure of the extent which has been washed away from Blackman's Head, I have not been up there for years.

2525. (*Capt. Washington.*) You stated that the Altar Bank is composed of clay and cement-stone?—Yes.

2526. A part of that has been removed by dredging?—Yes.

2527. Is Glutton Bank composed of the same materials?—I am sure I do not know.

2528. Would there be any difficulty in case of a ship losing her anchor and cables in running into Harwich Harbour and saving her?—Not the least, a vessel may come in at 18 feet at low water.

2529. Could not the largest ship of the North Sea fleet, 25 years ago, have come into Harwich Harbour?—I did not know Harwich Harbour then, it might at any time I have known it.

2530. With what draught of water?—At low water, a vessel may come in now at 18 feet; and any sized ship belonging to the British Navy at high-water, with any gale of wind that blows, if they can sail in.

2531. When you speak of any class of vessel, what draught of water do you refer to?—Twenty-five feet.

2532. There would be no difficulty in it?—No, not with a fair wind.

2533. What is the rise of the tide?—Twelve or thirteen feet.

2534. What is the depth of water at low spring-tides?—Eighteen feet.

[*The Witness withdrew.*]

Captain  
*Frederick Bullock,*  
 R. N.

Captain *Frederick Bullock*, R.N., examined.

2535. (*Chairman.*) How long have you been on this station?—I think I have been backwards and forwards three or four years.

2536. Are you aware of any injury done to the harbour of late years, and if so, to what do you attribute it?—Only from hearsay; I have not examined the harbour myself; that has been left to Captain Washington.

2537. Looking at the chart before you, you see a breakwater marked, which do you think would have the best effect, a breakwater in that direction or enclosing the shore in front of the Ordnance premises, and so giving a direct line to the tide?—I think the enclosing of the shore.

2538. Why?—Because by occupying the whole space you give effect to the tide; but here you do not; this (the breakwater) is too abrupt and too far out to have any effect.

2539. Do you consider that the enclosure of the bank along the low-water mark would have the effect of restoring in a great degree the natural run of the current?—Yes; because it appears to be restoring the natural boundary of the current.

2540. Do you know of your own knowledge of any injury done to the harbour by the removal of the cement-stone?—No, only from hearsay.

2541. Does not the lengthening of Landguard Point tend to give a protection to the harbour?—The extension of Landguard Point would protect the harbour, but will only protect the entrance of the harbour.

2542. From your experience and knowledge of the harbour, do you think it desirable to reduce the shingle at Landguard Point?—Yes, if it were possible, I think I would reduce it; but I do not think it is possible.

2543. You do not think that by any operation of the tides you could effect that?—No, I do not, for the tide is now so strong in the narrow channel near the beach, and yet the beach appears to increase.

2544. What do you suppose has occasioned the elongation of the Point?—The accumulated shingle from the eastward and the washing out of the excavation of the bay to the westward of the beach point.

2545. You think that the shingle from the eastward in gales of wind from the east comes in here?—Yes, it appears so to me.

2546. Are there any groynes along the shore to the eastward?—I believe at Felixstow there are a few, but not near the Fort.

2547. Do you think that groynes run out here would have the effect of checking the growth of the beach of Landguard Point?—Certainly, it would arrest its progress for a time.



2548. Groynes on Landguard Beach?—Yes, to the eastward of the beach point.

2549. If by any process, by groins or other means, you can prevent the beach extending further, will not it be better to leave it as it is than to attempt to act upon it by altering the tides?—My opinion is, that without some very great and expensive undertaking you could not act upon that by anything on the opposite side; indeed, I doubt whether any breakwater on the west would bring the current to act upon the beach point; for the strong tide is on the east, which it would be neither easy nor advisable to turn aside. The velocity of the tide on the east side of the harbour entrance is nearly double that on the west; it appeared to be running nearly four knots yesterday.

2550. You think that the breakwater would tend to prolong the tide, and that the other plan would tend to give it a fair direction?—Yes, by enclosing the low-water line.

2551. You prefer the latitudinal line to the longitudinal one?—Yes, I do infinitely.

2552. (*Sir Howard Douglas.*) You think that the great object should be by reclaiming the land opposite the Ordnance, to throw the current as much as possible to the eastern side of the river, and so to improve the Channel?—Yes, I think by that and other means the harbour would be improved.

2553. You have said that a breakwater running out from Beacon Cliff would be too low or too far out to have any effect on Landguard Point?—Yes, that is my opinion.

2554. Do you not think that, upon the principle of throwing the current as much as possible to the eastern side by the process of reclaiming, it might be advantageous to have a breakwater somewhat higher?—I should prefer it further in certainly; but my opinion is, that there is nothing which could be done to the tide on this, the west side, which would have any effect on the other side, as the force to be employed in this operation is the weaker.

2555. At what point would you propose a breakwater to be placed?—Commencing at the inner part of the land at the north-eastern point of the Harwich shelf, and leading the tide out in a fair direction to the entrance of the harbour.

2556. A breakwater springing obliquely from the north-eastern part of the shelf?—Yes, that is the only means to be recommended.

2557. (*Adm. Dundas.*) With all the alterations that you ever heard proposed, could Harwich be made such a harbour that ships of any draught of water could enter and leave it at all times of tide, wind, and weather, night and day?—No, certainly not; because the Channel on the outside has only, I think, 15 or 16 feet in the leading channel between the buoys, therefore it is fruitless to deepen the harbour beyond that; I take the depths from the chart before me. I have not sounded the harbour or the entrance.

2558. (*Sir H. Douglas.*) Have you of your own knowledge ascertained, and are you prepared to say what the consistency of those banks is?—I examined the material excavated the other day, the bank was composed of cement-stone and shingle, mixed with mud.

2559. Do you think that any part of it is deposit from the current?—I think it not unlikely, but that there would be no difficulty in removing the deposit.

2560. So far as it is the effect of deposit being removed it will come back again?—Yes, it would still be liable to return and must be attended to.

2561. Will you describe the anchorage at Hollesley Bay?—I have not examined it.

2562. (*Capt. Fisher.*) Do you think that Harwich could be made at any expense a harbour of refuge for ships of all sizes to take shelter in gales of wind?—No, not for ships of all sizes, for there would not be water.

2563. Of what draught of water?—I cannot say precisely, but taking this chart for my guide, and supposing that the plan is correct, I would say that 15 feet is the utmost.

2564. Are the Commissioners to understand that the knowledge you have had of Harwich is derived from hearsay and not from actual observation?—Some portion of it is from hearsay, and the view of this new chart of Harwich, and some from actual observation.

2565. Be so good as to say what part of it is from actual observation?—That of removing the shoals in the interior, by which the harbour would be materially improved and a great national benefit bestowed.

2566. You have no knowledge of Hollesley Bay?—No, it has not been recently examined, but it is in my orders to survey it.

2567. (*Chairman.*) Do you know anything about the pitching-ground?—No.

2568. Do you recommend the removal of the obstructions which are in the way of the western Channel?—Yes; indeed, I recommend the removal of all the shoals; I believe the whole of them can be removed at a moderate outlay.

2569. (*Chairman.*) Would not that have the effect of reducing the depth of water in the deep-water channel by the extending of the tide over a greater width?—Theoretically it might, but I think only in a very small degree practically.

2570. Have you ever measured the rate of the tide in Harwich harbour?—No, but I observed yesterday that it was running about four knots an hour.

2571. How is the state of the tides now?—Past the springs.

[*The Witness withdrew.*]

Captain  
Frederick Bullock,  
R.N.  
6th June, 1844.



Captain  
George Deane.  
6th June, 1844.

Captain George Deane, examined.

2572. (*Chairman.*) What is your situation?—I am a retired packet officer.
2573. How long did you command a packet on this station?—Nearly 30 years; I was altogether on this station more than 30 years.
2574. Are you a native of this town?—I am.
2575. And holding property in it?—Yes.
2576. You were never a pilot yourself?—We were our own pilots for Gottenburg and Cuxhaven, and the different northern ports.
2577. For how many years have you had a knowledge of this harbour?—I can remember it for more than fifty years.
2578. What is the largest ship you have ever seen in Harwich Harbour?—The largest ship with her armament aboard was a 50-gun ship, the “Brackel,” an old Dutch 50-gun ship.
2579. What was her draught of water?—I should expect about 20 feet.
2580. She was a flat ship?—Yes.
2581. How many ships have you known here of large size, men-of-war?—I cannot challenge my memory, but I have known frigates and many smaller ships-of-war.
2582. There appear to be two channels in the harbour, a deep-water channel at Landguard Fort and a western channel, are you aware of any change in them?—The eastern channel has diminished in depth and width very much.
2583. You are certain of that?—Yes, I am.
2584. Are you sure of that from your soundings, and having ascertained it, or only from hearsay?—From my soundings thousands of times.
2585. What is the difference between the depth now and what it was in former times?—I have not been at sea myself in active service for these ten years.
2586. On what authority do you assert that there has been this change?—It was changed very much before I left off going to sea, and I went out in Her Majesty’s steamship the “Blazer” with Major Beresford last year, and I found that where I could formerly sail in at low-water there is now beach at high-water.
2587. You could sail in formerly—in what description of vessel?—Vessels drawing ten feet, but there had been vessels of a much heavier draught of water than that.
2588. How do you account for the lengthening out of Landguard point?—I attribute it to the falling down and the washing away of the Beacon Cliff, commonly called Blackman’s Head, the which has been caused and accelerated by the excavating for the cement-stone.
2589. When did the excavation for the cement-stone commence?—I think about 20 years ago; but they always collected it from that shore before they began to excavate.
2590. By the removing of the cement-stone from the shore, has a barrier been broken down which protected the foot of the cliff?—In my humble opinion they have taken away the only barrier that protected the foot of the cliff, and that also turned the current against the south-west point of the beach.
2591. To what degree has the barrier been broken down?—Several hundred thousand tons have been taken away.
2592. How much land has been taken off?—The land has fallen down and been lost in consequence of the taking away of the stone.
2593. To what extent has land been lost?—The ground, within my recollection, must have lost twenty or thirty acres.
2594. How deep has it gone from the front?—I should think 250 yards within my recollection, nay, more since I was a boy.
2595. You mean to say that the sea flows up 250 yards further than it used to do?—Yes, and more too.
2596. Do you know of any cement-stone having been taken from any other places?—Yes, from Felixstow; but I was not an eye-witness of that; and also from the West Rocks, out to the south-east, they are raising it there every day.
2597. Did you ever hear of any complaint of the taking of cement-stone from any other property than the Ordnance property?—Yes; stone is taken by the lord of the manor of Dovercourt or his lessees.
2598. What is his name?—Nathaniel Garland, Esq.: Dovercourt is to the westward of the Beacon Cliff.
2599. Do you consider that the spread of the water diminishes the force of the tide?—Certainly.
2600. And that from that the mischief principally arises?—Yes; yesterday I was walking round the cliff and I saw a man with a basket on his shoulder grubbing the stone out from the foot of the cliff and taking it to his boat; that was not on the Ordnance property, but at the foot of the Parson’s glebe: the parson having only a life interest, cannot afford to go to law to protect his glebe, and it is depredated upon daily by the lessees of the lord of the manor.
2601. What would you propose to do to remedy this evil?—I would give it as my humble opinion that the replacing the barrier which they have removed would turn the tide against the point of Landguard Beach and prevent its further accumulation.
2602. What you would wish is to prevent its further accumulation, but not to diminish it?—I think it would also be desirable to diminish it, if possible; for you cannot come in with the Harwich Lights in one as you used to do.
2603. You state what has been the effect of taking the cement-stone from the front of



the Ordnance premises, but why should that have occasioned the elongation of Landguard Point?—Because the strength of the current which was turned formerly there is much diminished, the current at the ebb runs longer to the south-west, and does not exert itself against the beach point as before.

2604. Is it not more likely that the point is extended from the beach, coming along to the north-east of the point seaward?—The point washes from the north-east, I believe, but it was formerly carried away by the ebb-tide in a great measure.

2605. Do you suppose that the throwing groynes out will check it and prevent the mischief?—I have my doubts upon that subject, but I do not pretend to be an engineer; I think the tide ought to be turned against it; the tide runs longer out to the south-west; we could not row a boat in close to Beach End against the ebb formerly.

2606. Which is the worst shoal in the harbour?—The Glutton Shoal I think is the worst, but vessels may anchor in great safety outside that.

2607. Is not the Altar very much in the way?—It is.

2608. Is that increasing or decreasing?—I think it is decreasing; they have raised or dredged stone from that.

2609. What is the constitution of that?—It is cement-stone and platimore, or blue clay.

2610. Do you think the old ships sunk off the ship-yard do any mischief?—None whatever, Harwich would be very awkwardly situated without them, we could not discharge a cargo of coals without them during north-west gales.

2611. Do they effect any mischief by turning the current?—No, not in my opinion.

2612. It has been strongly asserted by Captain Bridge, that the placing the ships there has done very considerable mischief?—I do not place any reliance upon the evidence of Captain Bridge, especially respecting the “Bacchus,” who has stated what it is incongruous to suppose, viz. that so small a bulk as the “Bacchus,” should cause any retrograde motion or eddy of the tide placed at that distance from the beach, and it is wholly impossible.

2613. In what part of the town does your property lie?—In several parts; in Church-street, in King’s-street, and in St. Austin’s-lane.

2614. Does it lie near the shore?—No, one property is about fifty yards from the shore.

2615. This question was put to Captain Bridge by the Committee on Shipwrecks, “Is there any other point?” to which he replies, “There is one point. In the papers of Captain Washington, who was the naval surveyor on the eastern coast, he states the reason of the harbour of Harwich growing up where I have seen a 74-gun ship go out, and it is now six or seven feet above high-water mark; he imputes it to the taking away the cement-stone; now that is not the case, the ship-yard of Harwich is at a corner; 20 years ago the corporation had influence enough with the Government to get into their breakwater two old men-of-war, lying abreast of the town and another small brig: they laid that at the corner; before that the tide was so rapid you could not row a boat round it; but the tide in consequence went off into the middle of the harbour and joined the Ipswich water, and went with all its force against Landguard Fort: they had great difficulty to prevent the sea breaking into the Fort. If they were to take away that breakwater, my opinion is that the Channel would open of itself; the breakwater is of no earthly use but for the benefit of the ship-builder, for when it was not there the sand kept up so high it used to take them a great deal of money to dig away the shingle; since that has been there he has been at a great deal of trouble to underpin the wharf.” Have the goodness to state any objection to which you feel that is open?—I totally disagree with it in every point, because so small an object placed at such a distance as that is from the Beach End could never occasion the retrogradation or eddy of the tide so as to occasion an accumulation at Landguard Point.

2616. Are the ships placed there for the protection of the ship building-yard or for the general advantage of the harbour?—Two of the ships are placed there for the general advantage of the harbour—the “Ethalion” and the “Glatton.”

2617. How do they act for the advantage of the harbour?—By sheltering the landing-place from the W.N.W., winds; that is where the gales are most felt. The “Bacchus” has not been placed there many years, but there always were two ships there as long as any one can remember; there were two ships there when I was a little boy, where the “Ethalion” and the “Glatton” now lie.

2618. What would you propose to do to remedy all this?—It seems to me that by carrying a pier out from the Beacon Cliff or from the lighthouse, you would turn the tide against the point of the beach where it used to run before.

2619. (*Sir Howard Douglas.*) In your opinion, which is the best position?—I should rather say I would have it more to the northward, nearer to the small lighthouse. This Point (*Landguard Point*) runs out further than it did.

2620. In what way do you suppose the tide will act on Landguard Point in consequence of the erection of the breakwater?—By preventing the ebb-tide running to the south-west.

2621. How far would you propose the breakwater running out?—Six or seven hundred yards to the south-east.

2622. Which do you suppose will have the best effect, enclosing the whole front of the Ordnance ground to Beacon Cliff to the extent of three or four feet below low-water mark, or to throw out a breakwater?—I should think a breakwater would answer every purpose; that enclosure would be a very expensive work.

2623. Independently of the question of expense, which would be the best?—I have never considered such an enclosure, for I never could suppose it would be done.

Captain  
George Deane.  
—  
6th June, 1844.



Captain  
George Deane.  
—  
6th June, 1844.

2624. Why?—Because it is not wanted; small vessels sail over that part at high water.

2625. Would not the enclosure of this land give a fairer direction to the tide instead of an abrupt throwing off of the tide?—No; because I think that a breakwater is just what is wanted; there is 10 or 11 feet at high water over that shore, called the Guard.

2626. The question is as to the effect upon the shoals?—I do not think that would answer the purpose so well as a breakwater.

2627. (*Sir Howard Douglas.*) Your object is to throw the current over to the other side of the river as a remedy?—I want to turn the current to the south-east against that south-west point of Landguard Beach.

2628. Do you mean 600 or 700 yards from high-water mark or from the beach?—From high-water mark.

2629. Would it not be an advantage to the proprietors of property in the neighbourhood from which the cement-stone is obtained if the Ordnance were to cease to permit the stone on their property being taken?—I think it might be; but the Ordnance or their lessees excavate and take the stone from their own sea-face only; they did once manufacture it themselves.

2630. Is there any proprietor of land whose working it would injure the harbour if the Ordnance ceased working it?—Not any one *half* so much as the Ordnance, for their land lies just at the entrance of the harbour, and the others more to the westward; but there is no proprietor who does work it; there is no one who has the right; the lord of the manor affects to have the right; I am of opinion he usurps the right which belongs to the Queen.

2631. (*Lt.-Col. Alderson.*) If the Ordnance ceased working, is there any other person whose property lies near the harbour, whose working would affect it in the same way?—No.

2632. (*Chairman.*) Whose property lies near where the stone is taken?—The principal part is the Parson's Glebe. Mr. Sansum has a *small* property of cliff face; Mr. Patrick, Mr. Randfield, and Mr. Bagshaw, all small sea frontage.

2633. Those are all to the westward?—Yes, all out of the harbour.

2634. Does not the working there do a considerable mischief by narrowing the sort of isthmus that lies between the Stour and the sea?—Very much so indeed; that is going very fast.

2635. Then if the Ordnance should be prevented working in front of their land, ought not others to be prevented working in the West Bay?—There cannot be a question of that; whenever there has been a trial about it, it has always been lost; by the lord of the manor it is an assumed *manorial* right only, in my opinion.\*

2636. Actions have been brought against the proprietors of manors?—Not in this place, but it has been tried in Sheppey and in Walton; it was tried a year ago, and the lord lost his cause.

2637. (*Chairman.*) Has not a public representation been made to the Ordnance about the taking the stone from the front of their premises?—Yes; when I was mayor, a year ago, I sent memorials on the subject to the Ordnance, to the Trinity, and to the Treasury.

2638. Did you send those memorials on your own authority, or by direction of the Corporation?—I got the Council or Corporation to join with me; I *wrote* the memorials myself.

2639. All your complaints have been in respect of the Ordnance premises, not in respect of private property?—That which has been done on other property has not so much affected the harbour, it is further on to the westward.

2640. Will not it break through into the Stour if it is continued?—It will; but perhaps not for these hundred years; the parson will lose his glebe-land very soon; he has lost 10 or 12 acres since I recollect.

2641. What do you call the bounds of the Ipswich Water?—I must confess that in some measure they are undefined; there was a law-suit about the bounds, about 65 years ago, but it has never been completely settled.

2642. The Ipswich Water and the harbour have each their limits, and derive their revenues accordingly?—Yes.

2643. Do you know the amount of the revenue received for each?—I cannot challenge my memory; but the dues on a vessel's anchorage only, are only 4*d.* and for foreigners, 2*s.*; that is Harwich dues.

2644. Do you know the amount in the year?—No.

2645. Are there any harbour Commissioners here?—No.

2646. Who receive the harbour dues?—The Corporation.

2647. How are they collected and appropriated?—They are collected by the harbour master and appropriated to the current expenses belonging to the borough, to the maintenance of prisoners, and to keeping up the little paraphernalia belonging to the town; it is a very trifling amount; I think it does not amount to more than 40*l.* or 50*l.* a year; there are thousands of vessels that come and go that never pay at all.

2648. Who is the harbour master?—Mr. Styles, he keeps only a small skiff, and boards them at his convenience; there are thousands of vessels that go out without paying a halfpenny.

2649. If the Ordnance ceased working the cement and built up the sea-front as Mr. Bagshaw and others have done, would that improve the harbour?—It would prevent its going back and protect their own land; but it would not improve the harbour.

\* The lord of the manor has not *a foot* of land with sea frontage, where his lessees are excavating.



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2650. What number of boats are employed in the cement trade?—Sometimes 200 or 300, but they chiefly come from Kent; but few belong to the place; sometimes there are 100 and sometimes there are 200 employed; they come and go just as they please.

2651. How many men in each boat?—In some boats three, and in others more.

2652. (*Adm. Dundas.*) With all the alterations now proposed, and which could be made at an unlimited expenditure, is it possible to make Harwich such a harbour that ships of any draught of water could enter and leave at all times of tide, wind and weather, night and day?—I do not think it is; at high-water they could do so, but not at low water.

2653. What is the greatest draught of water that could be relied on at all times of the tide, day and night?—About 18 feet; but they must then be *well acquainted* with the entrance.

2654. You are understood to say that the old channel round Landguard Point into the harbour has been much diminished in width, and you have accounted for that by Landguard Point stretching out, but you state that it has been also diminished in depth?—It has.

2655. Is that in consequence of the point stretching over the deep water and leaving the shallow water towards the Altar, or is the present channel on part of what was the Altar?—The Altar has been altered by being a little dredged away, there is a little more water upon the top of it.

2656. Do they go over the tail of the Altar to form part of the channel?—No; they come over the western flat of the Altar, but they cannot go over the eastern part; there is as little as seven feet at that part at low water.

2657. There is a passage between the Altar and the point?—Yes; but very narrow.

2658. What is the width of it?—I should think not above 50 yards; I have not measured it not having been at sea for some years.

2659. If the beach filled up 50 yards more, it would join the Altar?—Yes.

2660. Very few vessels go in by that passage now?—Very few indeed, but there is very good anchorage for vessels outside, when not able to sail in.

2661. It is a safe anchorage, but not a very pleasant one?—It is very safe, there were a great many vessels there a week ago.

2662. (*Capt. Fisher.*) Where in your opinion would be the best place to establish an asylum harbour on this coast between Orfordness and the North Foreland?—At Harwich, *undoubtedly*.

2663. The question refers to a harbour capable of receiving ships of the largest dimensions, men-of-war and steamers, at all times of the tide?—There is no harbour on the coast capable of receiving ships of the largest size at all times of the tide.

2664. Where would be the best place to establish such a harbour?—My opinion is that one could *not* be made for heavy ships at all times of the tide. I do not know what could be done by steam dredging; that is a modern art altogether.

2665. In the event of such a harbour being made, could ships find the necessary supplies of water and fuel at Harwich?—Yes; I think they could, there is water at Landguard Fort, and at Erwardon also.

2666. They could obtain water and fuel, and the other supplies they might require without delay?—Yes, by means of boats; we have some springs in the neighbourhood; we have a well belonging to the corporation, about a quarter of a mile off, where they may have their supplies freely for the fetching.

2667. Is the anchorage-ground generally good inside the harbour?—It is very good, except close to the old ships; it is a little muddy and rotten there, but in general it is excellent ground.

2668. (*Sir W. Symonds.*) Have you an intimate knowledge of the anchorage in Hollesley Bay?—Yes; I have anchored there many times, and know the anchorage well.

2669. Can ships of the largest size, men-of-war as well as merchant-ships, sail through all the channels and find water at all times of the tide, day or night, from Hollesley Bay to Harwich Harbour?—Yes, to the outer part of the harbour.

2670. Do you consider the whole of the ground within the anchorage of Hollesley Bay good?—Yes; it is reckoned fair holding-ground.

2671. Do you consider it good?—Yes; I should say it is good holding-ground: vessels often part from their anchors there they cannot get them. I have known hundreds of vessels run up here with no anchors at their bows at all.

2672. You consider it good?—Yes; they lose their anchors, and that is one proof that it is good holding-ground.

2673. (*Chairman.*) How is the town supplied with water?—It is supplied from rain tanks generally; but there is a supply a quarter of a mile outside, where it can be had in dry seasons.

2674. Is not water so scarce that the people buy it?—Yes; sometimes they do; but they may have it if they will fetch it. There is plenty of water also on the Suffolk coast opposite. Plenty of water may be found when it is required. Ships could not get it from the rain-tanks; but it may be got from Landguard Fort, from Shotley, from Erwardon, or from a well we have a quarter of a mile from the town belonging to the corporation.

2675. And in abundance?—Yes: they used to take the water from this harbour to the North Sea Fleet during the blockade of Flushing.

2676. Is not the distress so great that within these few days the people have been obliged to send a considerable distance for water?—They need send only a quarter of a mile from the town; the neighbourhood of the harbour would afford water to any number of ships.

2677. Do you know what the anchorage is in what is called the Pitching-ground?—I



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never rode much there; but I never knew ships drive there; they lie rather uncomfortable; but they do not drive, they have four fathoms water.

2678. (*Lt.-Col. Alderson.*) Are not the cliffs on the coast of Suffolk crumbling away and falling into the sea, particularly about Dunwich?—Yes; I believe they are falling away there.

2679. Does the taking of cement-stone from Felixstow tend to injure the harbour by increasing the point at Landguard Fort?—I think it has that effect.

2680. You stated that you would prefer a breakwater run off near the lighthouse to one off Blackman's Head, do you think so because you consider Blackman's Head too low down to turn the current towards Landguard Point?—I think it would have a better effect near the Low Light, but I am not bigoted to that opinion.

2681. (*Capt. Fisher.*) You say that ships could sail at any time of tide from Hollesley Bay to the harbour?—Yes, to the entrance or rolling-grounds.

2682. Day or night?—Yes; particularly now that the Cork Ledge light is there.

2683. How is it that line-of-battle ships always anchor about three or four miles down instead of coming in here?—Line-of-battle ships cannot get into the harbour, except with a leading wind at high water and they cannot come without pilots.

2684. You have suggested a breakwater being carried out near the lighthouses in a south east direction, have you any other improvement to suggest to increase the capability of the harbour?—A little dredging on some of the shoals, the east end of the Glutton and the Altar might be much improved.

2685. (*Capt. Washington*) Questions have been put to you, as to whether Harwich is capable of being made a perfect harbour of refuge, accessible for the largest ships at all times of the tide. You have said that it is not capable of being so made for ships of the largest size; is it capable of being made a harbour of refuge for ships of a smaller class?—A perfect one; I never knew a ship to be wrecked in Harwich Harbour in my life.

2686. Is there any Government property on the north face of the town of Harwich?—Yes; the ship-yard, and the clerk of the cheques' premises.

2687. Would it not be in great danger, in heavy west-north-west gales, if the old ships were removed?—The ship-yard would be much inconvenienced, but I do not know that there would be much danger to the premises.

2688. Had a solid breakwater been erected there a century ago, would it not have been a saving of expense to the Government?—It might have been, for those ships do not last above 15 or 16 years, or at the utmost 20, I have known several of them in my time, there is a sea-worm which attacks and destroys them.

2689. Will they require other ships soon?—There is now an application to the Admiralty for another ship in place of the "Glatton," which will tumble to pieces as soon as the rough weather comes.

2690. Was it not in consequence of such a petition to the Treasury, two years ago, that Mr. James Walker was sent down to examine?—It was in consequence of a memorial which was sent up.

2691. (*Chairman.*) They are now digging a well to get down to the clay?—Yes; boring for water.

2692. When was it begun?—About two months ago.

2693. Is this the first boring?—No; they twice failed about 20 years ago.

2694. In what way did they fail?—They never got rid of the salt water. There is a salt spring 12 feet, and another 30 or 40 feet down, and the deepest spring is the saltiest.

2695. Is there any stone in this neighbourhood from which you could make a breakwater?—No, the nearest would be the Kentish Ragstone.

[*The Witness withdrew.*]

Mr. John Pattrick.

Mr. John Pattrick, examined.

2696. (*Chairman.*) Are you a resident in this town?—I am resident at Dovercourt.

2697. Does any property there belong to you?—I have property there; I had freehold property abutting on the sea formerly; there stood a mill, a house in which I lived, a granary, garden, stables, &c., which I hired in the year 1817, and purchased in the year 1824. The land is now, I may say, entirely gone,—so much so, that about ten years ago I had to remove my mill, to take the house down, and all the buildings; and that I attribute to the collecting the cement-stone close in to the cliff, taking it away, and even stubbing out the cliff containing it; in fact, I have had convictions before the magistrates of the borough of parties having done so: they have absolutely taken it out of my freehold and taken it to London.

2698. Do you sell any cement-stone yourself?—I do not; I am not allowed to take away stone, even when it falls out of the cliff.

2699. To what extent has the land you refer to been lost?—I suppose about three-fourths of an acre.

2700. How much has it gone back into the land?—There was a large meadow and a pond opposite to my freehold when I purchased it.

2701. What is the space of land between the sea and the Stour River?—I should think not above four or five hundred yards.

2702. How far have you removed your mill back?—I should think perhaps five or six hundred yards. I was obliged to remove it from freehold land to copyhold.

2703. Is this mischief going on?—It is going on to this day.



2704. What do you think would tend to prevent it?—The shelving the cliff down.

Mr. John Patrick.

2705. If the taking away the cement-stone were prevented, would that remedy it?—Certainly. I have seen pieces taken out of a deep bed of stone as if laid on purpose for protection; but the men who collect on the shore go with their mauls as soon as the stone shows itself, and, being soft, it drops to pieces immediately; then it becomes the property of the lord of the manor—they say they are entitled to it. I attempted to take some of it myself, but the lord of the manor said, “I will bring an action against you immediately,” though it is my own freehold; I think it is a very hard thing, possessing the freehold property, that I could not take the stone which came out of it.

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2706. Was that stone below low-water mark?—No, it is in the cliff; they absolutely maul it out of the cliff.

2707. Is there any action brought against those persons?—I have had them up before the borough magistrates, and have had a conviction; but it was not worth while going any further, for the men could not pay more.

2708. Have your proceedings prevented it?—No, for the men are out in the night doing it.

2709. What steps do you conceive should be taken?—I should recommend an injunction by the Lord Chancellor, to prevent the proceedings of the lord of the manor taking the stone away.

2710. Why do not the people who are interested take that proceeding?—It is a very expensive proceeding.

2711. Do you expect the Government to take measures for the protection of your property?—By protecting my property, they are protecting their own; the more my property is taken, the greater the Government suffer.

2712. What part of the Government property is injured?—The Beacon Hill, which belongs to the Ordnance. If the water makes up to our cliff, it must injure the Government cliff; the body of water is very heavy since I recollect; I have had possession of that property now 27 years.

2713. Do you know anything of the state of the harbour?—By our cliff falling down so rapidly the earth must be carried somewhere; there is no doubt, I think, of that when the earth falls to the extent of a quarter of an acre in one lump. I have a wheat-field abutting upon it; I have now a wheat crop, but it may probably give way altogether. I contend that the cliff washing away so rapidly must fill up the harbour. I am not a nautical man myself, and do not go upon the water much; but I conceive that it must tend to the filling up of the harbour.

2714. Do you know enough of the set of the tide to state that?—The tide, I apprehend, carries it along; it never comes back again; it is deposited somewhere or other. We have a little sand come up; at one time we used to have a good deal of stone come up, and shingle,—so much so that we used to mend the turnpike-roads from the shore; now we do not get any.

2715. You speak of three-quarters of an acre being washed away, do you mean on one occasion?—I have known pieces considerably bigger than this room go repeatedly. I have gone round and seen a little crack in wet weather; when I have gone again it was gone; being a very stiff clay, if it once cracks, and the water gets in, it will go very soon afterwards.

2716. (*Chairman.*) What do you think would be the remedy for that?—By footing the cliffs, and shelving them down.

2717. Footing by what?—By a concrete wall. There is a protection by Mr. Bagshaw, now done at a very considerable expense, that stands very well; but it cannot possibly stand unless his neighbour protects likewise his portion of land, which abuts upon it. That which was my freehold is entirely gone.

2718. How much of your freehold have you lost altogether?—It used to run in a slip; I have lost about three-quarters of an acre.

2719. What depth of land have you lost?—I should think about 100 yards in length by 50 deep, from the sea; the vicarage land adjoins this, which I hire from the Rev. Mr. Bull. I took it at a certain rental; the cliffs were falling so rapidly, and I was losing so much ground, that I applied to him for a reduction of rent, and he allowed me 5*l.* a-year in consequence.

2720. How long has this practice been going on?—I have known it 27 years.

2721. Was it so before they began to remove the cement-stones?—No; they were removing cement-stones, but not to the same extent as they are now.

2722. Do you know that they were removing it at that time?—Yes.

2723. (*Admiral Dundas.*) How many years have you resided there?—Twenty-seven years; from the year 1817.

2724. Did you, on your first taking it, know that the cliff was washing it away?—I could scarcely perceive it then; I had some property below, abutting upon the sea, below the vicarage. I hire 170 acres of land of Captain Deane, where I am obliged by my lease to keep up the sea-wall, when I took my farm 14 years ago. I have a heavy expense in keeping up those sea-walls; now, at the time I took it, the expense was scarcely 5*l.* a-year.

2725. If you, when you first took possession of your property in Dovercourt, had commenced by making a sea-wall, would you have prevented the mischief?—No doubt I could have protected it, as far as my own went; but if my neighbours did not take the same measures, mine would have been ineffectual.

2726. That is not the case with Mr. Bagshaw's land?—It is not wanted at present; but I apprehend it will be.



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2727. If the landowners had taken measures to protect the foot of their property, would not that have had an effect in saving the property?—They might have done it to a degree; but the lord of the manor threatened actions.

2728. Then what they ask to be done is that which they ought to have done for themselves; unless it can be shown that it is a public nuisance, can they expect that?—The lord of the manor threatened proceedings against any individual who would attempt to put shies or footings to protect their property.

2729. On what ground did he threaten?—Because we had no right to put a stick on the shore.

2730. Who is the lord of the manor?—Mr. Garland, who has a country-seat at Ramsey Hall, but is very seldom there: he lets the shore off; he used to have five or six hundred a-year for the cement-stone, but now they cannot get so much as they used to do; they excavate within 10 or 12 feet of the cliff; they go to the cliffs, and they get them out. I suppose that the rental is not above 300*l.* a-year now.

2731. Having exhausted under water, they now get it out of the cliffs?—Yes.

2732. Is he lord of the manor in which Mr. Bagshaw's property is?—Yes.

2733. He has not prohibited Mr. Bagshaw?—No, he has not.

2734. (*Chairman.*) Was there any allowance made to you to build a wall?—No; but there was a large meadow in front, with a large pond (which was the Wix Church's land); I used to go from my field into the barrack-ground.

2735. You bought it with your eyes open?—Yes, of course.

2736. If you had built a sea-wall as Mr. Bagshaw has done, you would not have lost your property?—I called on Mr. Bull, but, being incumbent for life, he would not do it, only having a life interest; and my neighbour on the other side would not do it.

2737. Do you think that the sinking of the cliffs has injured the harbour?—I think it has.

2738. What is the depth of the soil of your farm?—I suppose 15 or 20 feet, but the cement-stone is mixed with the clay.

2739. How low is your ground?—The earth is 15 feet down to the stone at the bottom.

[*The Witness withdrew.*]

Mr. Edward  
Killwick Calver,  
R.N.

Mr. Edward K. Calver, R.N., re-examined.

2740. (*Chairman.*) How long is it since you were engaged in the survey of this harbour?—Two years.

2741. Have you compared your survey with any of the old charts?—I have.

2742. Charts of what date?—1709.

2743. What is the difference you discover between the chart of 1709 and your present survey?—A considerable increase in the extent of Landguard Point, and a proportionate decrease of the Beacon Cliff.

2744. To what extent has Landguard Point gone out in that period?—500 yards.

2745. To what extent has the Beacon Cliff worn away?—500 feet.

2746. You state that on comparing the two charts?—Yes.

2747. Have you compared those with more recent charts?—The next is 1752.

2748. What is the difference between 1752 and the present time?—I have no record of the state of Landguard Point; there is no document to be relied on prior to Græme Spence's, which was in 1804.

2749. What is the difference as to Beacon Cliff?—Beacon Cliff is diminished in extent 450 feet since 1752.

2750. What do you suppose to be the occasion of this washing away of Beacon Cliff?—The quarrying of cement-stone at the foot of it.

2751. Do you know when the quarrying began?—I have heard, 30 years back.

2752. You have stated that the increase of the Landguard Point and the diminution of Beacon Cliff was in full operation before the removal of the cement-stone?—No; there was a small decrease in Beacon Cliff. We have no record of the other side.

2753. What do you suppose has occasioned the lengthening out of Landguard Point?—The decrease of the scour caused by the diminution of the Beacon Cliff and the rocks at the foot of it.

2754. Meaning thereby that the tide has a greater spread?—Yes; the tide, which formerly was thrown into a deep-water channel close round the beach, is now lost over a useless space to the southward.

2755. Do you think that the increase of the Point is occasioned from the shingle coming round from the north-east on the outside, and that the want of scour enables it to grow up?—I think that the want of scour is the cause; the want of scour has allowed the shingle to tail on.

2756. If groynes were placed there in sufficient number, do you not think that that would prevent any further increase of the Point?—It would till the beach had accumulated at the ends of them; this would occur in the course of years, according to the number of the groynes.

2757. What would you advise to be done to prevent further encroachment on the Beacon Cliff?—I would join the Cliff-foot Rock to the Beacon Cliff by a breakwater.

2758. What would be the effect of that, in your opinion?—On the ebb-tide the water



which now wastes itself over a useless space to the southward would be concentrated, and serve to keep steadfast the main channel into the harbour. At present the ebb-tide out of the harbour is lost to the southward.

2759. Suppose the useless space along the Ordnance property to be enclosed two or three feet below the low-water line, would not that give a fair current to the tide out and an increased current in?—It would increase the current a little at the first-quarter ebb, but would have little or no effect during the remainder of the tide.

2760. Why so?—Because it is already a flat, elevated a considerable number of feet above low water; it would not give the required direction to the scour; the scour is wanted more to the eastward.

2761. The object of that which you propose by the breakwater is to act on Landguard Point?—Yes.

2762. Will not the removal of the beach take from the protection of the harbour?—I do not think that any increased scour caused by the erection of a breakwater would have the effect of removing the beach; it would merely hold it steadfast, and prevent its accumulation westwards.

2763. You would check its growth but not diminish it?—I would not diminish it; it is, in fact, a benefit.

2764. Would you not be lessening it by throwing such a scour on that point?—No; I do not think the scour would have that effect; it would prevent its accumulation, but I do not think it would diminish it; if the Channel was contracted considerably it might; but a great part of the breakwater is projected on a site where there is little depth of scour.

2765. If you contract the Channel so much you must throw the great weight and power of the scour upon Landguard Point?—Looking at it, I think the capacity of the entire Channel is decreased about one-fifth, not more.

2766. Why so?—On account of the shallowness of the water near the position of the breakwater. Between the Cliff Foot and Landguard Beach is the main channel for the scour at present, and that has a depth of 22 to 16 feet, but the space proposed to be enclosed is only of a general depth of from 2 feet to 10.

2767. You admit that enclosing the land along the Ordnance front would have a good effect to a certain extent, but not to the extent required?—Yes.

2768. Would it not have the effect of securing the whole of the Ordnance property, and saving that from waste?—It would have that effect, besides improving the channels generally.

2769. Is it not a safer course to adopt a plan of that kind than to take the risk of what might be the effect of the very narrow channel which is proposed?—I do not think it at all likely that enclosing the dry space between the town and the Beacon Cliff would have sufficient power to bring about the effect required; it would have a slight influence at the first turn of the tide.

2770. Will not the enclosure in front of the town of the Ordnance property be restoring the boundary in that direction to its original and natural form?—It is the space at that point which has been taken away.

2771. Is there anything else which you would suggest to be done to improve the harbour?—I would dredge away a portion of the shoals in the eastern channel the Altar and the Glutton End.

2772. Do you know of stone being removed from any other part but from the front of the Ordnance premises?—Some ledges abreast of Felixstow were removed.

2773. Has that occasioned any mischief?—I should think that that alone would have done little mischief, if nature had not been disabled (by the removal of the Beacon Cliff) in the only means for overcoming it.

2774. (*Sir Howard Douglas.*) Do you think that the Altar Shoal is diminishing in size now?—We have no good document of reference to determine.

2775. Have you ascertained of what the Altar Bank is composed?—It is a general collection of mud, gravel, and cement-stone.

2776. Is any part of it deposit from the peculiar direction of the current?—I should think the main portion of it (or the Flat of the Altar) is deposit; but the Altar itself appears to be nearly all rock.

2777. To what point do you think the breakwater should be run out?—If it is run out too short, I think the effect will be lost before it comes the length of the Channel round Landguard Point. It ought to run from the Beacon Cliff to the inner part of the Cliff-foot Rock, so as to make use of the Cliff-foot Rock itself as a continuation of the breakwater.

2778. Then why not carry out the breakwater to the outer part of that rock?—Because the effect would be nearly the same without the erection; for the principal part of the rock is only two or three feet below low-water level.

2779. Of what material is the Glutton Bank composed?—The upper part deposit; I cannot answer further than that.

2780. If a more active current could be thrown over those two banks (the “Bone and Gristle”), part of that which has been deposited would be carried away again probably?—It is of too tenacious a quality to be affected by an increased current.

2781. But being deposited by the current, there is a particular velocity which would take it away again?—The velocity must be very much increased to effect that.

2782. (*Admiral Dundas.*) With all the alterations now proposed, and if made at an un-

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Mr. Edward  
Killwick Calver.  
—  
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limited expenditure, is it possible to make Harwich such a harbour that ships of any draught of water could enter and leave it at all times of the tide, wind and weather, night and day?—It is possible to improve it to any extent; but it may be improved at a small expense for all necessary requirements.

2783. What is the greatest draught of water which could be safely relied on now for a ship running in at all times of the tide, night and day?—12 feet.

2784. With the improvements which you suggest, what additional draught of water would you give?—15 feet.

2785. Your object in making the proposed breakwater is to contract the outlet on that side, and thereby to increase the rapidity of the current?—It is.

2786. Any other means which would produce the same effect would answer equally well?—Yes.

2787. How long have you been employed on this station?—From two to three years.

2788. Have you any other knowledge of this coast than that which you have derived during your time of survey?—For a period of eight years I have been constantly employed surveying coasts and harbours; on this particular coast I have been only three years.

2789. (*Captain Fisher.*) Are you aware whether ships-of-war and merchant-ships of the largest class can approach this harbour from Hollesley Bay at all times of the tide, in any weather?—They will pass over the shallowest water between the Andrews and the Inner Ridge Buoys in a depth of 19 to 20 feet at low water.

2790. Are there marks at present during the night for navigating those channels?—Ample.

2791. Are you of opinion that a harbour of refuge to answer all the purposes described could be made in Hollesley Bay?—For heavy vessels, I believe it is perfect at present; but for small vessels, it would require a considerable outlay; it is possible to make it a middling harbour for small vessels.

2792. Is the general anchorage-ground good in Hollesley Bay?—I have not a thorough knowledge of Hollesley Bay; but from the experience I have had of it, it is very good. With a short scope of cable while riding in Hollesley Bay in October last, we dragged the chain through the windlass.

2793. (*Chairman.*) Is Landguard Point composed of the same material as that which you have mentioned as the Beacon Cliff, or what is the substance which might be removed by the scour arising from the contraction of the entrance by the breakwater which you have suggested?—I do not think it would have the effect of causing any removal at all.

2794. What will be the rate of the tide acting upon the Point, in your opinion, if this breakwater is constructed?—From three to three and a half knots.

2795. What is the rate now?—Two and a half.

2796. That will make a knot difference?—Thereabouts, I should think.

2797. What is the depth of the Channel coming into the harbour at low water?—Twelve feet by the usual channel; but I could bring in a steamer drawing 18 feet by the deep water channel.

2798. What is the rise?—Twelve feet.

2799. Making twenty-four?—Yes.

2800. Speaking of spring-tides?—Yes, the springs rise from eleven and a half to twelve feet.

2801. Do you think that by any process it is likely to be made accessible to ships-of-the-line at high-water?—The erection I propose, with the alterations in the eastern channel, would make it accessible to ships-of-the-line at high-water.

2802. Do you think it would make it accessible to ships-of-the-line at high-water neap-tides?—To ships drawing as much as 22 feet.

2803. How do you propose improving Hollesley Bay for small vessels?—I would not, in fact, do anything at all there, though it is possible to improve it by raising the level of the Whiting.

2804. At low water how much of the Whiting is seen?—I have not a thorough acquaintance with it, but I do not think that any part of it is dry.

2805. What is the worst wind in Hollesley Bay?—From east to north-east.

2806. A ship anchoring to the westward would be sheltered from the east-north-east wind?—Partially.

2807. The way in which you would improve Hollesley Bay for small craft would be by putting an embankment on the Whiting?—Yes, but it would, after all, be imperfect as a harbour of refuge.

2808. (*Capt. Washington.*) Is there any point of this coast where a harbour of refuge could be formed for admitting all sizes of ships, in all times of the tide, wind, and weather, night and day?—I think Harwich offers the greatest advantages, taking all things into consideration.

2809. What was the old leading mark into the harbour round Landguard Point?—Walton Black Granary, on with the west window of Walton Mortella, in a depth of from 5 to 7 fathoms at low water.

2810. Where would that mark lead now?—Through beach elevated 7 feet above high-water spring-tides.

2811. What date are you speaking of that you could have sailed by the mark you have mentioned?—The year 1804, and I think as late as 1820; I am speaking of what I have heard from various authorities. [*The Witness withdrew.*]



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*Henry Vavasour*,  
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2812. (*Chairman*.) How long have you been in command of this district?—Since June, 1841.

2813. Have you ever known during that time of any representations of mischief done to the harbour by taking away the cement-stone from the Ordnance premises?—Yes; two memorials; I can give the reports that have been written upon that subject from the year 1825, with the opinions of Colonel Fanshawe, Sir George Hoste, and myself, up to a very recent period.

2814. What has been the effect of those memorials?—The reports on the memorials do not refer so much to the harbour as they refer to the Ordnance land, because they were not called for by the Ordnance, with reference to the harbour only. This arose in the shape of protection to the cliff and Ordnance lands, but there is no doubt that the allowing the Beacon Hill to waste as it has done for a series of years has affected this harbour to a very material degree. Any one who watches the way in which nature performs her part, cannot fail to see that if the stone had been allowed to remain as it was some time ago, the harbour would be in a different state from what it now is.

2815. Did the cement stone form a barrier?—Yes, it narrowed the channel of the harbour, and it gave a greater force of action to keep the harbour's mouth clear; *now* the ebb-tide is diffused over a very large surface, and materially weakened. The deepening of the harbour has never been brought before me as a professional man; it is only from viewing it, and from the different publications I have read, and conversations I have had with old seamen that I have formed my opinion. The harbour has been injured from another cause. There was a projection of rocks between Landguard Fort and the Deben River; that rock threw the shingle which came from the northward in a south-easterly direction, thus carrying it away by the flood-tide (this is my own idea, I do not assert that it is correct); thus the major part did not come down to Landguard Point. The rock being moved, allows the whole of the shingle to creep along the beach, and increase Landguard Point. Landguard Point, on General Mudge's Plan (the Ordnance survey 50 years ago) runs close round the Fort. At present it is some hundred yards extended into the sea. I doubt whether there are not, at some period of the tides, two forces acting in a manner to produce still-water near the Point, and thus the sand and shingle suspended in the still-water are deposited, and increase Landguard Point.

2816. How has that rock been removed?—I cannot say from my own knowledge, but I understand for the purposes of cement. To stop the increase of Landguard Point, I would carry out a mole to throw the shingle, which now moves down from the northward into deep water, so that it may be carried down Channel by the tide. Before the rocks were removed, Landguard Point did not increase. It appears to me to be prudent, on such occasions, to follow as nearly as may be the principle on which nature acted successfully.

2817. How would you improve the entrance to the harbour?—I should propose to carry a pier from the point of Beacon Hill to the Cliff-foot Rocks. I should myself prefer to take it from the Lower Lighthouse rather than from the Beacon Hill. I would rather carry it from the Lower Lighthouse to the Cliff-foot Rock. It is very evident that this will contract the harbour's mouth, and of course increase the power of the ebbing tide.

2818. Restoring by artificial means what has been taken away from the front of Beacon Hill?—Yes; this was a very excellent harbour, and it has become injured by quarrying cement-stone in front of Beacon Hill.

2819. Following up your idea of not interfering with the operations of nature, would not the bringing forward a wharf along low-water mark in front of the Ordnance property tend to restore the former state of things?—That was my first idea, but nature will raise part of the land between high and low-water mark; if you erect the breakwater from Beacon Hill; and this also (Mill Bay) will fill partly, as there will be still-water there.

2820. As a work immediately to be undertaken, would you recommend enclosing the front of the Ordnance property, as well for the sake of the protection of the Ordnance property as for giving full vigour to the tide?—I think I would carry out a breakwater first, for the other can easily follow; that will improve the current immediately.

2821. You propose, then, a simple breakwater?—Yes; no doubt the enclosing part of the land between high and low-water in front of the Ordnance property would be a better thing, provided the wharf continued as a mole to the Cliff-foot Rock; I should take it out to the edge of the deep water.

2822. That would occasion a great additional expense?—I am aware of that, and therefore I proposed the breakwater.

2823. Might not the contraction of the harbour to that extent act with so much force upon the Landguard Point as to carry off the beach, and expose the harbour more to the sea?—There is no doubt it would expose the harbour more to the sea if the point is carried off, and the mouth enlarged.

2824. Do not you suppose it would have the effect of taking off the point?—There is no doubt it will take off a portion of the point; but I have doubts as to the effect of running streams, whether they will affect materially the beds of harbours, &c., &c., at certain depths of water. I think you must dredge first, and the current will keep the harbour's mouth clear. But I do not know of any experiments tried to show how currents affect the beds of rivers. I believe you will have to dredge in the first instance; but I have no experience on which I can base that opinion.

2825. (*Sir Howard Douglas*.) If the breakwater is taken out and it acts too rapidly on the Landguard Point, that cannot be remedied?—The object is to go back to nature.



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2825\*. The erection of a breakwater does not appear to be following nature?—In its effect I think it is.

2826. You do not think that simply increasing the shoal in front of the Ordnance property would be sufficient?—No; the current cannot afford to lose a single particle of force, which it must lose should such plan be adopted in preference to carrying out one of the two works proposed. I have read with great attention this paper of Captain Washington's which has been sent to me, referring to the loss of land and the damage in consequence, and I beg to say that I concur in every word which he has written. If the Commissioners wish to get information with regard to the protection of the Ordnance lands, I can afford it. I have gone on gradually erecting groins, but the Ordnance do not grant money sufficient to erect all the necessary groins at once; they have this year granted 350*l.* and last year 300*l.*, and the year before 300*l.*

2827. You consider that the injury to the harbour arises from the formation of the shingle, and that that has been occasioned by the removal of the stone at Felixtowe?—The injury to the harbour has arisen from two causes, viz., the removal of cement-stone from the front of Beacon Hill, and the removal of stone from the cliff at Felixstowe. The supply of shingle comes from the northward, and unless you stop that supply it will still come; you cannot destroy the power which brings that shingle down, and you do not give the shingle a different direction.

2828. Would a breakwater along the shore tend to preserve the Ordnance property?—Decidedly it would; but the Ordnance property will be so protected by the groins which are being put up that it is not necessary for Ordnance protection; it might tend to secure the property to the use of the town. The Ordnance might probably be induced to place the main defence in advance; I, as an officer of engineers, would rather have it higher up with batteries *à fleur d'eau* in front.

2829. (*Chairman.*) It has been stated that great injury is done in Mill Bay by the cliff wasting away in consequence of taking the cement-stone, and that the distance from thence to the Stour is only 380 yards; do not you apprehend great danger if something is not done to check that?—Most undoubtedly, taking away the cement-stone tends to admit the sea to destroy the cliff; but I think the major part of the injury is already done; they have taken away almost all the stone they can get they are now going down four feet to dig up the stone at that level. They say they do no mischief by digging such holes; but I think if every point of the plane is lowered, that is lowering the whole plane certainly. I have endeavoured, as far as I possibly can, to stop the digging; but the Ordnance have granted a lease to Mr. Alder, the cement manufacturer, and they cannot prevent the digging unless they grant a new lease. I suspect that to prevent the quarrying on Mr. Garland's manor the Government will be obliged to go to the House of Commons. The manor, I believe, is let. Some of the people round complain that their property is injured. I wish to add to the evidence I gave, that in 1842 I put up groyne, marked No. 1 on plan, which now effectually protects the part of the cliff where the sea made the first advance on the river Stour. Late in 1843 I erected Nos. 37, 38, to protect the left flank of Mr. Bagshaw's property. These last are collecting beach and will protect the foot of the cliff in due time. Thus the sea will not advance on the River Stour, as apprehended, through that part of the Ordnance land.

2830. Do they take away the necessary measures to prevent it?—I do not know whether they have taken any steps to prevent the quarrying. To protect their cliff by a wall is an expensive work. An officer of engineers sent in an estimate of the expense at 33,000*l.* If the committee will walk across the Barrack Field, they will see how thoroughly and effectually some of the groynes protect the cliff.

2831. It is in evidence that the people have taken away the stone in the night-time?—I do not know what is done on private grounds. I brought one man before the magistrates, and he was fined for stealing stone at night; now it is not taken from the Ordnance land within the 50 yards reserved.

2832. Where do they get the cement-stone now?—From the West Rocks, the Ordnance manor, and Mr. Garland's manor; they buy it at 3*s.* 6*d.* Ordnance stone, and 4*s.* 6*d.* West Rock-stone a-ton. There are 50 yards reserved from the foot of the cliff, of which I am the guardian, and I preserve the stone on that portion.

2833. (*Admiral Dundas.*) You were understood to say you would leave it to nature to restore this harbour?—No; I would restore to what it was as far as I could, when it was a good one before nature was altered.

2834. Was it a good one before those old ships which lie there were moored off the town?—That I cannot tell; they were there when I came.

2835. Have the Ordnance power to put an end to the lease?—Yes; by giving six months' notice; I believe the lessee would be willing to execute a lease leaving out the power to take cement-stone from the Ordnance manor.

2836. What would you do?—Stop their taking any stone from the Ordnance manor. I can speak only as to the Ordnance manor.

2837. The lessee pays 300*l.* a-year for his premises, with permission to work any part of your ground except 50 yards from the cliff?—Yes; he may go anywhere he pleases in the manor within the points named in his lease.

2838. Do you apprehend he gets many cement-stones from the Ordnance premises?—He gets very little now, for he has taken almost all he could take.

2839. That is the reason probably why the rent was reduced from 500*l.* to 300*l.*?—I cannot say; that was before I came here; there was a great abundance of stone formerly.



To show this there is a ledge of rocks mentioned in one of the Reports, and the officer writes, "At the extreme south point it is not probable that the sea will ever throw up sufficient materials to form a beach over the ledges."

2840. (*Sir Howard Douglas.*) What is the date of that Report?—The years 1826-27. Here is the decrease from time to time of the land of the Ordnance (*showing it on the plan*). In 1709 that was the boundary (*pointing it out*); that in 1745; that in 1809; that was the state in 1830; and this was the one I put in myself in 1843 (*pointing out the spots*).

2841. Would the breakwater you suggest from the lower light do away with the necessity of those groynes you have referred to?—Of some of them certainly, if done immediately.

2842. Have you any idea of the expense?—Each of the groynes 150 feet long cost 84l.

2843. How many is it proposed to have?—25.

2844. Would not the necessity for the whole be prevented by the breakwater?—Not of some of them; but if they are not put down immediately the land will go.

2845. The carrying out of the breakwater would have the effect not only of deepening the channel but of preventing the necessity of the erection of the groynes?—Yes; of deepening the channel and saving some of the groynes; that is my opinion decidedly.

2846. What is the length of the groynes?—150 feet; I first had them 100 feet, but I have added 50 feet; but they need not all be the same length; that depends on their situation.

2847. (*Chairman.*) Do you know whether there is material in the vicinity of Harwich suitable for the construction of such a breakwater as you suggest?—No; there is no stone about us; the cheapest way would be to get the Kentish Rag-stone from the neighbourhood of Maidstone.

2848. What depth of water would the channel have with the alteration you propose?—You might bring it to any depth, it might be brought to its old depth, which was seven fathoms, by dredging, and the current will then keep it open.

2849. (*Lieut.-Col. Alderson.*) Though they are not working the cement-stone within 50 yards, the bank still goes?—Yes; because where there are no groynes, the sea washes the foot of the cliff. There is not a large portion of stone on the 50 yards. The lower the height of the plane extending from the foot of the cliff seaward, the greater the injury to the cliff from the action of the sea; by removing cement-stone the plane has been lowered, and a greater body of water advances to attack the foot of the cliff. Before the quarrying, that plane was high; now they have lowered it, the advancing wave comes up with more force to the cliff.

[*The Witness withdrew.*]

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Mr. Lewis Cottingham, examined.

2850. (*Chairman.*) What is your situation?—I am a plumber, and the owner of small vessels.

2851. Are you constantly resident here?—I am; I am a native of the place.

2852. Are you aware that any injury has been done to the harbour of late?—Yes.

2853. To what do you attribute that?—I attribute it to two causes; first, the removal of two natural breakwaters, namely, the ledge of rocks from Felixstow Cottage, commonly called the Governor's Cottage. The removal of that barrier, I conceive, altered the course of the current; at the time the ledge of rocks remained it threw the current to the southward away from Landguard Fort; the removal created an eddy which caused an accumulation at Landguard Point. The other cause was, the taking away of the cement-stone on the Harwich side, which has also caused an accumulation on Landguard Point; at the time the barrier existed it kept the tide to the eastward towards Landguard Fort, and by that means the Point was kept clear as it had been for at least 100 years. Then there is the removal of a natural ledge of rock-stone which projected from the Beacon Point, which was commonly called Blackman's Head, that was formed up to the height of from four to six feet; there was a considerable quantity of cement-stone removed from the Ordnance and manor containing, I believe, 355 acres, including 80 acres of Ordnance shore, which has occasioned much mischief.

2854. How long has that mischief been going on?—I consider about 18 years.

2855. You had not been sensible of anything of the kind before that?—No; my opinion is, that the cliff did not go so rapidly; it would go of course in a degree from the exposure to the wet and the sun, and so on; but the removal of this natural breakwater (the cement-stone) has caused it to go at a rapid rate. An uncle of mine, who is now 80 years of age, who owned that property which Mr. Bagshaw has lately fortified with concrete, felt so satisfied of its safety that he built houses upon it.

2856. What would you recommend as the remedy?—To carry out a breakwater from the point of Beacon Cliff to the extent of from 500 to 800 yards. I consider that that will throw the tide over to the eastward, and would prevent Landguard Fort Point further progressing,

2857. Do not you think the effect of the tide would be the washing away of a part of Landguard Point?—No, I think not; but it will keep it clear: it may possibly have some tendency to diminish it, but I think not to any extent.

2858. Suppose the front of the Ordnance property to be enclosed, would the effect of that be better or worse?—I should rather fear the effect of that; my conviction is, that a

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breakwater from the Beacon Cliff would have a better effect. I think it would throw the tide over, and have an effect on Landguard Point by stopping it. The enclosing the frontage, I think, would have a tendency to create an eddy which might be unfavourable, and probably cause a breach between the Boat House and Landguard Fort.

2859. (*Admiral Dundas.*) Has Mr. Bagshaw's wall completely sustained his land?—It has; my uncle, who previously owned the property, put up groynes; but he received a notice from a solicitor threatening him with an action, and that deterred him from continuing those groins, and induced him to sell the property at a great sacrifice, the houses being in great danger unless they could be protected.

2860. At what draught of water can a ship enter the harbour now at all times of the tide?—In its present state, a ship drawing twelve feet only; but I am not a sailor; I have merely a pleasure-boat, and am occasionally on the water.

2861. With all the improvements which you would suggest or which you have heard suggested, what would be the difference in the draught of water?—It would at least maintain three fathoms.

2862. Do you think a ship drawing 18 feet water could come into the harbour at all times of the day and night after the improvements?—Yes, I am confident of that.

2863. You have no knowledge of the depth of water in the channels?—Yes, from coming over in the packets occasionally, and from sailing out with my vessel (about 20 tons) over the shoals to ascertain the nature of the soil, and sounding the channels at the time. I also take the management of the tide-gauge for Captain Washington; and can tell what depth of water at any time there is in the channel by reference to the gauge.

2864. Do you know how many men are employed in the cement concern?—I should say from 400 to 500.

2865. Do they live entirely by it?—Yes.

2866. What is the number of vessels out of Harwich employed in the North Sea fishery?—At present not more than 10; formerly there were 60 or 70 sail.

2867. Has the number much diminished of late?—Yes.

2868. At what period were there 60 or 70 sail?—About 30 years ago.

2869. What has been the cause of their falling off?—From parties who were in the trade dying, and others not taking it up; and every year there used to be one or two vessels lost on the Dogger Bank.

2870. Is it not the fact that there is a greater spirit of enterprise on the part of the Dutch?—I am not aware of it; but there may be.

2871. Perhaps those engaged in it have got too rich?—That may have had an effect on some.

2872. Have they not found the cement-trade pay better?—I do not know; there has been so much competition in that trade; it may pay those who have purchased the stone, perhaps, but not those who dredged it up; I am not aware of any smack-owner embarking in the stone-trade.

2873. (*Sir Howard Douglas.*) Is it understood that the proposed Railroad Company will give 30,000*l.* towards constructing the pier?—That I have understood.

2874. Do you know it from any authority?—I have heard it from the chairman of one of the Companies.

2875. Do you believe it?—I have an assurance from Mr. Duncan, the solicitor of one of the Companies, that they will expend that sum, and the construction to be under the approval of the Admiralty; and I believe Mr. Duncan has sent a written statement to that effect.

2876. Do you attribute the falling off of the fishery, or of trade generally, at Harwich, to any deterioration of the port?—Not at all.

2877. Would there be any difficulty in dredging away the shoals in the harbour to the depth of 15 or 20 feet?—I consider, not any. I have recently been on the Committee for dredging the harbour, and we have set on a dozen boats for the purpose of ascertaining what could be done by dredging, and have got 518 tons of soil composed of clay, mud, and cement-stone; and there is about one-eighth of cement-stone which they have collected. I feel quite confident that those dredging-boats will reduce the shoals and give a much greater depth.

2878. Can that be done by local vessels?—Yes. There is now lying on the shore at least one-eighth part more of small cement-stone, also the same quantity of copperas (which has been collected by the boats), which the Harbour Committee had employed men to collect. The copperas-stone is worth 6*s.* per ton, after paying expenses of the freight to the Chemical Works at London; but in consequence of the Commanding Royal Engineer at this port stopping the workmen from collecting it, at present the value of it is lost. It would, if sold, reduce the expense of dredging the shoals more than one quarter.

2879. (*Capt. Washington.*) Do you think that the Altar Bank or any shoals thereabouts are formed by deposit from the river?—No, I think the Altar Bank and the Altar Flat are a formation from the cliff, which was a continuation of the land, and the cement-stone was part of the formation from the natural soil.

2880. Do you happen to know how near beneath the surface cement-stone is found?—The cement-stone runs about six feet from the surface of the cliff; if you take up the surface of it by going from four to six feet down, you come to another; and at some parts only two feet.

2881. You say that 500 tons have been dredged up?—Yes.

2882. Do you think they have deepened six inches in doing that?—Yes.



2883. Do you know the fact?—No, I compute only from the quantity of yards, 518 cubic yards.

2884. Do you think that they have dredged to the extent of one foot?—No.

2885. You believe that they have brought up 70 tons of cement-stone in dredging?—Yes.

2886. Is there any Government property on the north face of the town?—Yes.

2887. Would it not be in great danger if the old ships were removed?—Certainly. The old ships placed, on the north side of the town for breakwaters, are of first-rate importance in several points of view: they form a defence to the quays and Government property. By them an inner or safety harbour is made, without which there would not be a safe spot to lay ships ashore for delivery of their cargoes or for repairs. The breakwater ships are supports for Her Majesty's revenue cutters and other vessels requiring their bottoms cleaning or examining; and it is a well known fact that the revenue cutters on the Yarmouth station have come to Harwich for the purpose of using this accommodation, which could not be obtained there. The decks of the breakwater ships are also useful for depositing the stroes, and for preparing, stretching, and serving the rigging of the vessels when refitting.

2888. Had a solid breakwater been erected there a century ago, would it not have been attended with a great saving to the Government?—There is no doubt of that.

2889. (*Chairman.*) Are the vessels in a sound or a bad state at present?—In a bad state; the "Glatton" particularly is in a very dangerous state; and if she is not removed soon, and a pier or a breakwater erected in her place, there will be great danger to the Government property, and the north part of the town; but for those ships, the greater part of the north face of Harwich would have been washed away.

2890. If the Government keep possession of their property, the building the pier will be the cheapest thing?—Yes, certainly it would be the cheapest thing to erect a solid breakwater at once.

2891. If Mr. Rendel's plan of a breakwater and a pier on the north face of the town were carried out, would it not afford ample protection and enable steamers to land their passengers at all times of the tide?—Yes.

2892. Is it your opinion that 30,000*l.* will do that?—Yes, it is.

2893. How much money has been expended in the dredging by the dredging-boats you have referred to?—At present we have expended 98*l.* 15*s.*

2894. At what depth will your dredging-vessel work?—Any depth required

2895. Are the lips of the buckets powerfully armed with steel?—Yes.

2896. Have you two sets of buckets?—Yes; each boat uses four.

2897. You have raised 518 tons?—Yes.

2898. In that do you take credit for the sale of the cement-stone?—Yes.

2899. What did you get for the cement-stone?—We got 14*l.* 17*s.* for the stone.

2900. (*Capt. Washington.*) Was not the sum of 100*l.* voted by the corporation for the express purpose of proving to the Harbour Commissioners and the Admiralty that the shoals could be easily dredged away at a very trifling expense?—Yes, I was one of the Council who voted for it.

2901. (*Mr. Walker.*) You have referred to building a breakwater or pier, of what materials would you propose building that?—I propose building it of Maidstone or Kentish rag-stone, in length 800 yards, breadth 8 yards, and the mean depth 4 yards, which I find will amount to 25,600 tons; that, at 5*s.* per ton, will amount to 6400*l.* for the stone only.

2902. What do you take for lime and building, and so on?—I consider that a dry pier would have the effect.

2903. Have you an estimate of the total cost, including building?—No, I have only the amount of what they would bring the rag-stone for.

2904. What would they lay it at?—I suppose 6*d.* per ton.

2905. Have you made any estimate of the cost of such a pier?—No, I consider that the expense of placing the rag would not be great, not more than 6*d.* per ton; but I am not an engineer.

2906. Have you made an estimate of the whole cost of such a wall?—No.

[*The Witness withdrew.*]

Mr. Richard Hales, examined.

2907. (*Chairman.*) What is your occupation?—I am clerk in the Royal Naval Yard.

2908. Do you consider the ships that are sunk at the end of the town necessary for the protection of the harbour?—I do.

2909. Do you think it highly desirable that the breakwater proposed by Mr. Rendel should be constructed?—I do, for the following reasons; namely, as a protection to the sea-faces on north front the wharves of the Government-yard and that part of the town where, from raging weather and spring-tides the sea makes a breach over them, and must in many instances, have been destroyed but for such protection. And again, the present contracted convenience of shelter in the inner harbour or pound; that of lying vessels on shore to examine their bottoms for cleaning or repairs, which, from the state of the weather, cannot be done at all times, as when the winds are raging from the north-west to east, which Mr. Rendel's proposed pier would amply guard against. I beg to offer a few remarks upon its further advantages: revenue cutters are often ordered up from Yarmouth

Mr.  
Lewis Cottingham.

6th June, 1844.

Mr. Richard Hales.

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Mr. Richard Hales.  
6th June, 1844.

to survey their bottoms and examine defects which cannot be done at that port, it being a bar-harbour ; also Government vessels generally, and even the surveying steamers which are stationed at this port, might be accommodated, and likewise take on board their supply of coals without delay, alongside the pier at any time of tide. And being the only port of refuge on the eastern coast, it frequently occurs that mail and other steamers are driven into this port for shelter and supply of coals which have now to be sent off in boats in boisterous weather, which occasion great delay. During the winter seasons numerous damaged ships, from getting ashore or otherwise are brought into this port, which require their cargoes to be discharged, and the state of the ships examined, which many of them, from their draught of water and water-logged state, cannot be laid in the present constituted inner harbour or pound. And it has occurred that ships under the circumstances I have mentioned, have been towed by steam to the port of London, when, from the facilities now offered by the proposed pier by Mr. Rendel, the removal of ships would be obviated.

2910. The Railroad Company have agreed to give 30,000*l.* for that purpose?—So I understand.

2911. Are you not on the Committee?—No.

2912. You have merely heard that?—I have only heard it mentioned.

2913. Supposing a pier were not to be built, will it be necessary to have some more ships sunk there?—Yes, the ships are getting into a decayed state now ; it will be necessary soon to replace them.

2914. Without that what would be the effect?—The effect would be that we should lose part of the Crown property ; the sea would have such an effect upon it, it would range it away.

2915. Do you think that the sinking of the ships there has had an effect on the tide injurious to the harbour?—I do not know that their lying there has had an effect injurious to the harbour.

2916. Has their lying there altered the tide so as to produce injury?—Not that I am aware of.

2917. What do you consider the cause of the injury to the lower part of the harbour?—I consider the falling away of the cliff, and the taking away of the cement-stone to have produced it.

2918. In what way do you think that could be best remedied?—By constructing a pier or breakwater from where the present ships lie sunk, and continuing it up to the westward.

2919. From whence do you propose having the breakwater proceed?—I should continue it out in the present line and bring it into the river, and more round to the easternmost part of the harbour.

2920. What is your object?—To turn the tide ; but I did not expect to be questioned upon this, only the inquiry to the town and Government yard.

2921. What number of old ships have you known used here from time to time?—I have known 13 old men-of-war in my time.

2922. What number of years?—Fifty years.

2923. Frigates and sloops?—Yes, there have been two sixty-fours and the “Glatton.”

2924. Do they fill them with stones?—We sink them and scuttle them, and put ballast in to keep them down.

2925. What did they cost you?—The ships are supplied by Government.

2926. Have you any knowledge of the navigation of the Channel either into the harbour or leading into the harbour?—No ; my knowledge is confined more to the Government yard.

[ *The Witness withdrew.* ]

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*John Chevalier Cobbold, Esq., examined.*

*John Chevalier  
Cobbold, Esq.*

2927. (*Chairman.*) In what profession are you at Ipswich?—I am a banker at Ipswich, and interested in mercantile affairs in Ipswich generally.

2928. Are you enabled to give the Commissioners any information with respect to Harwich Harbour?—Is the inquiry as to the importance of it to the port of Ipswich?

2929. Is there anything you can state as to the improvement of the harbour?—I do not know that I can give any suggestion as to its improvement ; I can only state that in the opinion of our ship-owners, it has materially deteriorated at the entrance to the port of Ipswich.

2930. To what do you attribute this deterioration?—Of my own observation I do not know that I can give any very valuable information ; but my impression is, that the great alteration has arisen from the removal of the cement-stone at different times, which has altered the current ; but how it has had that effect I cannot say.

2931. What has been the effect produced by that alteration?—The effect has been on the opposite side, Landguard Fort, the land has run out very considerably. I have a place at Felixstow, about two miles north-east of Landguard Fort, from which spot a great deal of cement has been taken ; and since it was taken away, the sea has encroached and taken away a part of my garden : I can speak to it for 20 years ; for the last few years they have ceased to take away the stone, and the encroachment of the sea has not gone on to the same degree.



2932. Have you adopted any steps for the security of the land?—I have not myself, I have not been possessor of the place till of late; I have had an offer from the contractor here who does the Ordnance work, to put out some groynes, which I have thought of doing.

2933. You do not think that the mischief now going on requires more than the putting out those groynes?—I do not think of doing more than that; it is a very expensive work.

2934. Is the water at Ipswich diminishing?—I think it is not; we are laying out a great deal of money in dredging; we have laid out 100,000*l.* in docks within the last four years.

2935. What sized vessel goes up?—I should think at present about a 200 tons vessel; but we have constructed the docks with an entrance to accommodate vessels of 400 tons. We have, within three miles of Ipswich, from 15 to 16 feet at low-water, at a place called Durham Bridge, and are deepening the river from that place up to Ipswich, at high-water to 17 or 18 feet, to take up vessels of from 300 or 400 tons.

2936. What is the greatest number of vessels that you have known at Ipswich at one time?—We had last year entering at Ipswich, inwards, 1155 vessels, besides those vessels which came in ballast; outwards 855, but a very great many vessels go outwards in ballast because we have a large proportion of colliers; and I think belonging to the port there are 167 vessels: I think the average tonnage of the vessels of the port may be about 80 tons.

2937. Are there any harbour dues?—There are tonnage dues, from which we received last year 1,496*l.* for the year ending the 8th January last, on vessels the tonnage dues varying and increasing gradually from 1*d.* a-ton for vessels under 50 tons, to 1*s.* 6*d.* a-ton for vessels of 300 tons and upwards; then we have, besides that, a duty of 1*s.* 6*d.* a-ton on coals, amounting to about 5,000*l.* a-year.

2938. Can you suggest anything which should be done for the improvement of Harwich Harbour?—That is rather an engineering question; I presume that if the entrance could be narrowed so as to sharpen the current, that might have the effect of increasing the depth of water.

2939. Is there anything you would wish to state yourself with respect to the depth of water?—Nothing, but to impress upon the Commission the extreme importance of this harbour to the port of Ipswich, which is an increasing port; and where we are laying out a great deal of money in improving the port itself.

2940. In what way?—By our docks, and by deepening the river.

2941. Have you any interest in the railroad?—Only as an inhabitant of Ipswich, and having an interest in the bank here.

2942. Do you understand that the Company are willing to pay 30,000*l.* for the building a pier here?—I heard that stated in the Committee of the House of Commons, but I have not taken any part in that railway; I have been promoting another railway to Ipswich.

2943. (*Capt. Washington.*) Is not the preservation of the entrance of Harwich Harbour essential to the port of Ipswich?—Certainly.

2944. (*Chairman.*) How is the money you receive for harbour dues and for duty on coals expended?—About 5,000*l.* is paid as interest on the 100,000*l.* we borrowed to do the work, and the 1,500*l.* a-year beyond that defrays the expense of the dock and river, and management: the year's average of our income gives about 6,500*l.* a-year.

2945. With such an income as that, the people of Ipswich are capable of taking care of themselves in improvements, are they not?—Yes, we take care of ourselves from a place called Levington Creek, the limits of our commission; but 5,000*l.* a-year of our income goes for interest on our expenditure already incurred.

[*The Witness withdrew—Adjourned.*]

## LONDON.

*Monday, June 10th, 1844.*

Admiral Sir T. BYAM MARTIN, in the Chair.

*Lawrence Holker Potts, M.D., examined.*

2946. (*Chairman.*) Where do you reside?—At Blackheath.

2947. What is your profession?—A physician and surgeon.

2948. What is the object of the plan which you have to submit?—The formation of harbour breakwaters, of simple structure, principally by means of sinking tubes, more particularly applicable to foundations in sands.

2949. Have you ever tried your plan practically on any part of the coast?—No, I have not; I applied to the Admiralty by memorial at the recommendation of Lord Haddington, and I received in answer that they had kindly transferred the matter into your hands.

2950. How long is it since you first proposed this plan?—I have had similar matters under my consideration for the last five-and-twenty years or more, having accidentally been placed near the coast in Cornwall.

2951. Have you ever showed your plan to any committee?—No, never.

2952. Not before the Committee on Shipwrecks?—No, it is quite recently that I have turned my attention to this particular department.

2953. Will you be good enough to enter into an explanation of your plan?—It having appeared to be a great desideratum to have a more ready means of forming foundations in sands and deep waters than any means hitherto afforded have given us, I contrived

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Cobbold, Esq.*

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*Lawrence Holker  
Potts, M.D.*

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the means, which I shall have the pleasure of showing the Commissioners, of drawing tubes rather than forcing them into sands, mud, and other similar substances.

2954. What do you mean by "drawing tubes"?—By taking off the pressure of the atmosphere from the interior of the tube, forming, in fact, that action which we well know by the name of suction; I draw a current of water and sand or other material through the tube; the ascending current of water carries with it this sand and other matters miscible with water; the ascent of these materials with the water displaces the substance or soil, unfooting, as it were, the pipe, which we would cause to descend; but really one moment's inspection of the working-model will render it much more clear than my description.

2955. Are you not prepared with any written statement of your plan?—I have the specification of my patent, which was enrolled a few days since, but that is very long.

2956. The Commissioners wish for a distinct account of your invention, making it as succinct as you can; will you be good enough to exhibit your plan by your model?—I shall be happy to do so. (*The witness exhibited his plan by inserting a tube in the sand and extracting first the air and then the sand and water by means of the air-pump.*)

2957. (*By Dr Potts.*) The sand passes over into the receiver; this sand is used in forming the cement to unite fragments of rock into solid artificial rock. Having by means of a set of tubes, which in England we should make of cast-iron, formed parallel walls, we fill the interstices between them with fragments of rock from the cliff; these stones may be united together by means of a vessel with compartments, in which sand and shingle with roman-cement or lime, or other cement, which may be mixed together. We pass this into the sea-water under the surface and cause the compartments to open in succession: the contents are passed down dry, and by means of the sea-water they unite on the spot the fragments of rock, so as to form the whole of the interior into one solid artificial rock. Thus under water we have the power of forming a solid rock, which appears to be infinitely superior to concrete or other semi-plastic compounds, which are generally made use of; this is shingle and sand mixed with roman-cement; it forms a substance much harder than chalk (*the Witness produced samples*): this sticks to the vessel it is formed in so firmly that it is with difficulty we break it off. I have used different matters to form cements cheaper than roman-cement; I make use of these for the purpose of uniting the fragments of rock; it is solid in five minutes; in working under water with jointed or flexible tubes we have this advantage, that instead of an accidental leak drawing air we draw water, which percolates slowly, and does not derange the action of the pumps. I have been told by some persons that they have tried to get a steel-bar into the sand, but could not effect it to any considerable extent, while I effect it at once by this air-pump.

2958. Suppose this to be carried on in a place like the Goodwin Sands in any exposed situation, could this apparatus be worked there conveniently?—Yes, in that case I should propose to put down a series of tubes, which may be fixed together with flanges, as the gentlemen engineers could do much better than I could; I merely claim the principle. By a succession of tubes we should get a footing.

2959. You fix them in a sort of groove?—Yes, and having a degree of curve given to them collectively, we should oppose an arch to the action of the sea. In forming a break-water, for greater security, I should tie the tubes together, uniting them into one perfect body by lateral bolts, and thus extend it into the sea to any distance one perfect case of iron.

2960. These tubes go down one by one?—Yes, in places where iron is not so cheap, we have the means by bolts of taking off three sides of each tube, leaving only the interior plate as a protection to the rock.

2961. Is there any wood in any part of your structure?—No, but in places where we choose to make use of it we could pass down tubes or plates of wood prepared by Payne's or other processes.

2962. Is that part of your plan?—I would leave all that detail to the engineers who take my principle and work upon it. This is an application of a principle which hitherto has been made nothing of. The idea must have struck others of pumping down tubes into quicksands, but until I introduced this recipient the pumps must have become choked; by this means we avoid all trouble of deranging the action of the pumps and get a ready mode of discharging the sand, &c. This method of sinking very large tubes is a result which I hardly imagined when I set about it instead of sinking large shafts or caissons with closed ends; I found the use of a smaller or operating tube effect my purpose readily: by this means I could get down very large tubes: it appears to be the very reverse of the plan on which Mr. Bush went; he forces air down, but I exhaust.

2963. What do you call a large size?—Eight feet diameter or more; those being bolted together as with a kind of diaphragm occasionally across. This (*diagram A.*) shows the means by which I should propose, if it be the pleasure of the Government to set me to work on the Goodwin Sands, and I think I could get to the bottom of the sand. I suppose this (*the inner tube B.*) to be of sufficient diameter to be capable of permitting a man to descend; he carries an elastic hose with a trunk which he directs in the inside of the larger tube to be sunk, he applies it to the sand, and the current being formed, sucks up the sand and water together, thus undermining the foundation of the latter, consequently it sinks.

2964. He pumps it to the top?—Yes, if the distance be less than 30 feet; if more, I should apply the jointed tube or hose to the top, or have successive lifts, or make use of a diver with a diving helmet. From the same boat air is forced down to supply him, and the action of other pumps is kept up to extract the sand. Some eminent French engineers



asked what can we do in the case of the “*Télémaque*?” I said, supposing the depth of the sea too great for other means, I should send down divers with helmets, who should be supplied with my operating tubes, which, being directed to the spot to be searched, would carry up the sand and water with great rapidity. We have tried our power at 28 feet above the surface of the sea; we should in fact, from a boat, have to make only an exhaustion of three or four feet, the sea-water being that depth from the edge of the boat. In sinking tubes into sand, the assistance given by the sea is considerable, for if your recipient be placed at low-water mark, you have at high tide about 20 feet above it to assist the upward current of the sand and water in your tubular piles.

I had a fancy that we should meet with sand so interminable that we should be obliged to unite the tubes so as to form a compact aggregate; therefore I formed a plan of forcing lime pastes or cements down by hydraulic pressure through the tubular piles, so as to unite them together, using short tubes alternately with the long ones, and thus form an aggregate by agglutinating the sand; but that does not appear necessary in most cases, for there are few sands in existence, as far as I can learn, in which we could not go down readily to the bottom.

2965. At Dover there is not sand?—There is some, I think. By letting down a tube or machine with exhausted air you could ascertain the depth of the sand. The exhausted receiver being set in action, you might draw up the sand, and know the distance between that and the solid rock.

2966. You do not profess to act anywhere where there is not sand?—Yes, it is not of the same importance; but by means of tubes you would be able to carry out foundations with comparative ease in deep water to any distance that might be found necessary.

2967. How are the tubes set on the rock?—By their being bolted together and tied with bars. Supposing we have carried out tubes with bolts between, and they were carried down to the rock; those tubes are let down by the exhausting principle, which gives the power of sinking tubes with readiness one after another, footing them through quicksand, shingle, &c., in the chalk.

2968. Supposing there is no sand, as is the case at Dover, what should you do?—Then I should send down the tubes one after another and bolt them together.

2969. Would they have any hold of the ground?—No, no deep hold, merely a footing in the chalk; they would stand by themselves and be like a wall, piece by piece, held together by lateral bolts, and transverse and diagonal ties or bars of iron securing, and secured by, the artificial rock which they enclose.

2970. Your system would not be applicable to Dover?—I think, eminently so.

2971. Supposing no sand to exist there, how would it be applicable;—I should pass down my tubes, beginning from the shore, and fill the space with chalk from the heights above, a succession of masses of tubes, and fix them as fast as I could get on, thereby I should carry out my artificial rock to any extent.

2972. What is there new in that?—Possibly there is nothing new in it; but I do not know that tubes have ever been used for such purposes before, and in such a manner.

2973. Suppose this to be the shore at Dover, you take different lengths of trunks?—Yes, and make an iron wall there; I fill up with large stones united with cement, so as to form a perfectly satisfactory rock, and if the game is worth the candle, you may, with the shingle, make a rock harder than any rock we have in that part of the country.

2974. Suppose you had to commence in deep water?—There would be a difficulty in beginning in six fathom water; I should prefer carrying on the work from the shore; but that may be done, though not so easily.

2975. Your printed paper speaks particularly of the Goodwin Sands and other sands?—Yes.

2976. Suppose you inserted these in the Goodwin Sands, would not the action of the tide and waves carry away the sand from about your piles which are thus opposed to them?—Yes. I have provided for this contingency, by affording facilities for the insertion of fresh piles, but it might be an object to have the sea wash away the sand; we can always continue our bulwarks so as to leave it in steps, or conveniently approachable by boats or larger vessels.

2977. Then there would be a great depth of water outside, perhaps six, seven, or eight fathoms?—Yes; we can withdraw the tubes when they become useless in the interior, and carry on a succession to any distance which may be thought desirable; but the difficulty I have anticipated is in getting through the hard sand (*The witness showed the operation of the air-pump in extracting the sand*). This shows the way in which the tube is sunk into the sand; it also shows that after the tube is emptied of sand and water, it remains empty for a length of time, only filling by slow filtration, so that a man can descend and work the small or operating tube in the large tube without any inconvenience from the flow of the water within. The deeper we are in water, of course the greater the filtration; but it is supposed the Goodwin Sands are of very firm texture in the centre.

2978. You suggest the idea without explaining the practical operation?—I am not conversant with the terms and technicalities of engineering but from the opinion of those practical men who have seen my inventions, I have no doubt but professional engineers would be able to carry them out much better than I could.

2979. Are there any engineers who have inspected it and expressed their approval?—Yes, several eminent ones; amongst others, Mr. Alexander Gordon and Mr. Brunel.

2980. Would Mr. Brunel join with you in the experiment?—I do not know; I have not as yet asked him.

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2981. When you speak of those gentlemen having seen your plans, the question is to what event they approve of them?—That I cannot say altogether.

2982. You feel no doubt of being able to carry down a line of these tubes, eight feet in diameter, of which the bottom should be made to reach the rock below the Goodwin Sands?—Yes.

2983. It is proposed to sink to the chalk by means of the exhausting principle?—Yes; my crude idea was to put on the Goodwin Sands a kind of T which would afford a protection to vessels in all winds; I have been on the Sand, and it appears to me that by means of penetrating the Sands, I should be able to keep my tubular piles perfectly vertical.

2984. Have you seen the sea on the Goodwin Sands in a gale?—Yes; there I should leave the tubes as a breakwater, so high as to show above highest tides.

2985. (*Lt.-Col. Alderson.*) You propose to send those cast-iron piles down to the rocks, affording an opportunity for having on the top a lighthouse or battery, or whatever might be required?—Yes.

2986. Is there anything else you wish to explain by your model?—No; not by this model.

2987. Your object in proposing this plan is merely that if the Government approve of it, they should take it in hand and execute it themselves?—Exactly so.

2988. You do not propose on your own responsibility to undertake any expense?—Not unless I am requested to do so.

2989. To give it to the Government, to let their own engineers work it out?—Yes.

2990. You have a patent for it?—Yes.

2991. You propose to give it to the Government for a compensation?—I have no fear on that head but that I shall be handsomely dealt with.

*Mr. Walker.*—I do not think that it is necessary to trouble Dr. Potts by asking any question further, but I should wish in his hearing to state what I understand to be his principle, that if he can further explain it he may have an opportunity of doing so. His principle is to sink a pipe or pile, or other foundation, down through the quicksand to the rock, or to a depth that any erection may be placed upon it; and that he does by applying to the inside of the tube a pump, which draws the water and the quicksand from the bottom. The way in which that, according to the present mode, is done, is by means of dredging or what is called misering, which is by means of a scoop or bucket attached to a pole, or otherwise, drawing up the sand, and allowing the pressure at the top of the vessel or pile to sink it; but the manner in which he proposes to sink the pile or vessel, by means of exhausting the sand within it, and the mode of exhausting it, is to me perfectly new. I have never seen it before, and I confess that the tube descending, as it appeared to do, somewhat surprised me; it was a result I did not expect, I admit: there is ingenuity attending it,—how far practically it may be applicable is another thing; but I cannot help saying that, as far as I can judge, the invention of Dr. Potts has a great deal of ingenuity attaching to it. This principle of exhausting would not be applicable, I take it, to cases where there is rock only; it must be sand over the rock: and even if it were shingle, or anything but sand, I do not think that part of his principle would be applicable.

*Dr. Potts.*—I am obliged to Mr. Walker for his opinion. I wish the Commissioners to have the kindness to see the apparatus working in my place; they will be astonished to see the power of it, even in removing shingle so as to form a foundation; till they see it they can form no conception of its capabilities. I contrived the means of turning the larger tube round, and made it saw-like at the lower edge: thus, as it were, trephining or trepanning the rock, I got a firm hold, and rendered it water-tight; but it appears to me that in most cases this is useless labour,—that as soon as the pile is fairly down to the bottom, and bolted to the tubes at its side, and to those opposite, it would do without the necessity of trephining it into the chalk; but matters of this kind are so obvious to a man who is possessed of the principle, that I do not think it is necessary to detain the Commissioners with the detail; I shall be happy to show it them at my house, No. 9, Buckingham-street, in the Strand, which is in the immediate vicinity.

2992. Have you any printed statement of your principle?—No, only a little thing I drew up, and which I perhaps circulated a little too freely.

2993. Without some statement or diagrams, to give your view of it, persons not conversant with this matter can never sufficiently understand it?—I should rather the Commissioners exercised an unbiassed judgment upon their view of the experiments and models than on anything I could say.

2994. Will you furnish a written statement of your plan, with diagrams explaining it?—I shall do so with pleasure.

[*The Witness withdrew.*]

Commander  
William Crispin,  
R.N.

Commander *William Crispin*, R.N., examined.

2995. (*Chairman.*) Were you on the Portland station for any time?—Yes.

2996. In what service?—I was first of all stationed there in a revenue cutter, the “Swallow.”

2997. How long were you there?—I was for two years on that occasion constantly on



that station, and I have been in the habit of frequenting it during the last seven years, while in command of the "Vulcan" revenue steamer.

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2997\*. Have you been in the habit of passing in and out between Portland and the Shambles in the night?—Yes, at all times.

2998. If you were coming in from sea with a large ship in a heavy south-west gale, would you come within the Bill of Portland and the Shambles, or go to the eastward of the Shambles?—I should, with flood-tide, come inside the Race, between the Race and the Bill, and between the Shambles and the Bill.

2999. In heavy weather?—Yes.

3000. In a large ship?—Yes.

3001. You would not go to the eastward under any circumstances?—No, unless with ebb-tide, I should not, knowing it so well as I do.

3002. What is the common practice of pilots, do they go between the Shambles and the Bill, or to the eastward, in the night time?—I cannot say positively what their practice is; but if the wind was at all from the westward, they would have to beat up, and could not get into Portland Roads so well by going to the east.

3003. The Commissioners find generally among the people of Weymouth that they go to the eastward of the Shambles?—They may do so; but the Channel pilots know little of the Race as compared with what we employed in the Revenue Service do, who are in and out by day and night so constantly. I never, in the "Swallow," attempted to go outside the Race; I always steered right for the Bill, and was sure to get round.

3004. Do you think that a vessel going to the eastward of the Shambles would do it without a light at the end of the Shambles or a cross light?—I have been at the east end of the Shambles frequently, but could never tell exactly when I was round them; you can only judge of your distance by the lights and bearings.

3005. Have you ever had much thought about a breakwater?—Yes, a good deal.

3006. What is your opinion as to the line it should take, and the distance it should go out, and what its bearings should be?—My idea of Portland Roads as an anchorage for vessels wind-bound is, that it is so good that it does not require a breakwater at all.

3007. You are opposed to a breakwater there altogether?—I think so, the anchorage is so very good.

3008. Do you think that it would be a safe anchorage for a convoy of 50 or 100 ships, with an easterly gale of wind?—Not for so great a number as 100 ships to lie there.

3009. What you speak of is for one or two vessels?—No; I should say 30 vessels could with safety. I never knew a vessel drive with an easterly gale of wind when in a proper berth.

3010. You consider a breakwater there unnecessary?—I think so.

3011. Is there not a great deal of sea tumbling in there with an east wind?—Not if you anchor in the proper position.

3012. With a fleet of 50 sail?—I should think in a fleet of 50 sail some would do so, and find much sea.

3013. Is there not a great deal of sea coming into the anchorage with an easterly gale?—With an anchorage for 50 sail of ships, the outside ships would certainly experience a great deal of sea.

3014. Would not a breakwater give them protection from that sea?—If run out to a sufficient distance from the island.

3015. How far would it require to run out?—I cannot say with certainty.

3016. The Commissioners understood that you had something particular to state with respect to Portland, they were therefore anxious to see you; if you have any information to give they will be happy to hear it?—I was not aware of that. My knowledge extends along the whole line of the coast, as I have been for the last seven years employed in the "Vulcan" for the protection of the revenue, and my cruising-ground extended from Bristol round the Land's End to the Thames.

3017. What do you know about Beachy Head?—I have often anchored there.

3018. On which side is the best anchorage?—On the western side.

3019. Off Seaford Head?—Under there.

3020. Do you know much of the eastern side of Beachy Head?—Yes; I have anchored there, at Eastbourne, and all along the coast, my duty having required me to anchor in those spots to send away my boats for the protection of the revenue.

3021. What sort of ground is there in front of Eastbourne?—I cannot say exactly what kind of ground it is.

3022. Is it a rocky bottom?—From anchoring every night on different parts of the coast, I cannot take upon myself to say exactly the different sorts of ground in different parts, but I never found any inconvenience in anchoring off Eastbourne from a rocky bottom.

3023. You are aware of the Royal Sovereign Shoal?—Yes.

3024. And other shoals along that coast?—Yes.

3025. Is there not a great deal of foul ground between the Royal Sovereign Shoal and the Eastbourne Shoal?—Yes.

3026. Supposing, as a seaman, you were called on to state on which side of Beachy Head you would make a harbour, on which side should you say?—The western side decidedly.

3027. For what reason?—Because I think the ground is better there, and you can come nearer the shore.



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3028. Suppose a breakwater off Eastbourne, at the distance of a mile and a half or two miles, boats could never communicate with the shore in easterly gales, could they, with the surf on the shore?—I should say not.

3029. Consequently if they had a breakwater two miles off they must have a harbour within for small vessels?—Yes.

3030. Having a breakwater off Seaford, they would have Newhaven open?—Yes.

3031. (*Admiral Dundas.*) Suppose, in case of a war, it were felt to be necessary to have a port where steamers could go in at all times of tide, wind, and weather, and to have a port of refuge for merchant-vessels, where would you recommend such a harbour between the North Foreland and Beachy Head?—I should say Beachy Head would be the most eligible spot along the whole coast for a harbour of refuge.

3032. Suppose you had a harbour of refuge at Beachy Head, which would be the second to the eastward?—Dungeness; I say Dungeness, because I think a merchant-vessel would always get from one point to the other in one tide.

3033. Why should you prefer Dungeness to Dover?—Because you could always approach it at all times of tide.

3034. The question refers to a breakwater like that at Plymouth. Where would you select a spot, between Portsmouth and the North Foreland, where a harbour on a large scale could be made?—I should say Beachy Head in the first instance, then Dungeness; I think that vessels coming up Channel are clear of all danger as far as Dungeness, that is one reason why I would place the harbour there; secondly, if a vessel runs up as far as Dover she would naturally run on for refuge into the Downs?

3035. Suppose you combine that harbour of refuge with a position for steamers to go in and out at all times of the tide to watch the coast and annoy the enemy?—One place would be nearly as good as the other for that purpose.

3036. Could a steamer go in any weather from Dover to Dungeness?—Yes; she ought to have power sufficient.

3037. Would you think it an advantage to have a port such as has been described at Dover where there was an inner harbour, and where vessels could be repaired?—The great point must be its accessibility during all times of tide; with a steamer, that is every thing.

3038. Will you refer to that plan (*the plan of Mr. Cubitt for Dover Harbour*), do you consider that a harbour such as this is better placed off Dover, where there is an inner harbour for vessels to repair than if built at Dungeness where there is no accommodation of that kind, particularly as you have stated that a steamer can always get up in any weather from the Downs to Dungeness?—I would prefer Dungeness, taking all things and circumstances into consideration connected with the maritime interests of this nation.

3039. You are supposing them to tide down Channel always?—I think that in the coasting trade they generally do so; vessels leaving the Downs would reach Dungeness very well; whereas, getting into this refuge harbour off Dover would be no distance.

3040. If you wanted a place for the protection of the Downs for a squadron of steamers, what position would you take for a harbour?—Dover, certainly, for the protection of the Downs.

3041. Looking to the opposite coast, where would you have an English steam-squadron stationed in a harbour to watch it?—Dover or the Downs, as certainly the nearer you could get to them the better.

3042. For the merchant-service you think Dungeness the most eligible?—Being obliged to place a harbour between Beachy Head and the Foreland, I say that Dungeness is the most eligible for the merchant-service.

3043. Which should you prefer for the war-steamers?—They would lie as well in the Downs as anywhere else.

3044. For watching the opposite side, you would prefer Dover?—Yes; as a harbour of refuge, but I would as soon lie in the Downs in a steamer as in any harbour, provided I could get coals, &c., there.

3045. Combining the two together, the men-of-war and the merchant-service, which of those two would you have, supposing only one to be provided?—With the object of watching the opposite ports, and for a man-of-war station, Dover would be the best, as it would be nearer the ports they had to watch; but taking the two points into consideration together; if there were only one, I should say Dungeness, as it is only an hour and a half's steaming, after all, between Dungeness and Dover for war-steamers.

3046. Suppose a breakwater to be erected in the East Bay at Dungeness, as it must be outside of the Swallow Bank, could boats communicate with the shore in an easterly wind without further protection inside?—I should think they might; but I have never anchored there in an easterly gale, therefore I cannot say positively.

3047. Could an army embark there with an easterly wind?—Yes; if you could take the ships round the Ness point, as I have been lying on the west side of Dungeness when it has been blowing hard from the eastward, and I did not find much sea on the beach.

3048. If you were at night to the eastward of Beachy Head, and a storm with rain came on, and you had it in your power to have an anchorage, and a breakwater to the westward and another to the eastward with a strong south-west gale, for which should you run, on the weather-shore or the lee-shore?—That would depend on the formation of the breakwater, but if I could obtain shelter in one or the other, I would rather go to the harbour to the westward of Beachy Head.



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3049. In running into Portland Roads, ships very often go outside the Race and inside the Shambles?—Yes; there is a very good passage.

3050. That is the general passage of all ships, is it not?—No; I think that they go outside the Race: men not very well acquainted with it, go outside both.

3051. (*Sir B. Martin.*) In case of a war, and that we were obliged to have a squadron off Portland to watch the Channel, would it not be necessary to have a breakwater?—Yes; in that case it would be most desirable.

3052. And for the collection of convoys?—Yes; as regards communication also; if you wish to make Portland a harbour of refuge, it would be very much better with a breakwater than without one.

3053. Is not that in contradiction to your former evidence?—I did not consider the former question to refer to a harbour of refuge, but merely as a roadstead. I have always been used to speak of a breakwater at Portland with reference to it as an anchorage to bring up and afford protection to ships wind-bound. I beg to be allowed to correct my answer if it is put to me, whether, as a harbour of refuge, a breakwater is not wanted in war, where steamers could coal and vessels could be protected, I should say decidedly place a breakwater at Portland. I have always anchored, the Portland point bearing south-south-east.

3054. In what water does that point bear S.S.E.?—Five and a half fathoms.

3055. What room is there in that spot for vessels to lie?—They can lie from the Castle, where they load the stone, along to the point of the slide.

3056. Supposing a breakwater run from Portland and followed into the Bay, would that be sufficient to protect a fleet of merchant-men in a foul wind, and also steamers so as to obtain for them the facilities of coaling and so on?—No; I would rather extend it further out.

3057. If it was a mile and a half, would you have a passage between Portland and the breakwater for vessels to run out, or would you join it on to Portland?—To make it complete, I would have a passage between the breakwater and the land, for they would find it difficult sometimes to beat round the north end when the wind chops to the northward and eastward very suddenly.

3058. Would you have an opening between the land and the breakwater, or would you have it in the middle of the breakwater?—I would have the opening between the land and the breakwater, not in the middle; for this reason, they could haul round very close to the shore the instant you got past that point called the Slide.

3059. Suppose they were going to the south, they might weather round the land from the opening in the middle?—I would rather go outside in that case.

3060. Is there not a danger from hugging that shore too close, from the gusts of wind that come off?—No doubt it is very squally, and you would certainly get the gusts more suddenly close in shore; but I never saw any accident in consequence of those squalls.

3061. How far off do you meet with those gusts?—You get them a mile off, but not so violent as close in with the shore.

3062. (*Sir H. Douglas.*) Where would you put your southern entrance, into the harbour close to the shore, or would you build a pier into three fathoms water, and then make an opening into five fathoms?—This short pier into three fathoms water would be very easily built, and would be a great safeguard to vessels running through the opening.

3063. You would place your breakwater in Weymouth Roads, as it is placed in Plymouth Sound, a detached breakwater?—Yes; with the exception of the short pier running from the island into three fathoms water.

3064. The first question that was asked you was, if it were considered necessary that a harbour of refuge should be provided in the Channel between the North Foreland and the Isle of Wight, where would you place it?—I should say, Beachy Head.

3065. That is supposing there were only to be one?—Yes.

3066. You know the Downs?—Yes.

3067. You know the Ness and Beachy Head, and you say that there is very good anchorages at each for merchant-vessels when the wind becomes foul?—Yes.

3068. But you say, if one harbour of refuge were made, you would place it off Beachy Head?—Yes.

3069. Those places are very good anchorages; but in the event of a war, it will be necessary to make a further provision, where men-of-war can be laid along with the merchant-vessels to protect them—men-of-war and steamers, where they can coal and water—would you then prefer making that harbour of refuge at Beachy Head in preference to the Downs?—If there was only to be one, I should prefer Beachy Head, as the most central point, and most clear of dangers for vessels to approach.

3070. Considering that all the vessels that come down the river take refuge from the south-west winds, would you prefer to come further that way to Beachy Head rather than make some little alteration in the Downs, so as to convert that into a harbour of refuge?—I go upon the principle that there would be no harbour of refuge between the Downs and the Isle of Wight; vessels can always anchor in the Downs for shelter.

3071. But there is no harbour of refuge there?—No; but we always look upon it as capital good anchorage now, and that we are generally safe there.

3072. You are not safe against an enemy there?—No, unless you had protection stationed there.

3073. Supposing a harbour of refuge were provided in which men-of-war, and men-of-war steamers can lie and protect the vessels?—I have given the thing a good deal of



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study while I commanded a steamer; and I think it would be necessary in case of war to have a sort of block-ship, with guns mounted, on many parts of the coast; and between which and the shore I would make all merchant-vessels anchor.

3074. Admitting that you could protect vessels in the Downs, would you consider it necessary under those circumstances to erect a breakwater two miles off Dover, so as to take in a large fleet of merchant-men that have to be protected by men-of-war steamers and line-of-battle ships, and so on?—No, I should not.

3075. Supposing a breakwater made from Sanddown Castle over to the Brake, there would be a very large space, supposing the same sort of breakwater made off Dover, should you prefer that to the space within a breakwater off the Downs?—One would be as good as the other; but as regards the harbour off Dover, were I placed in a situation to have it said to me, you will form a harbour of refuge between Beachy Head and the North Foreland, and you will protect the trade of your country also, I should say, place block-ships in the Downs, and make all merchant-vessels anchoring there anchor between them and the shore; I would then place the harbour of refuge at Dungeness.

3076. (*Lt.-Col. Colquhoun.*) You are aware that block-ships may be burnt?—Yes, certainly.

3077. (*Capt. Fisher.*) It appears that your answers to the former questions, where in your opinion an asylum harbour should be constructed, have been principally in reference to ships homeward bound; where in your opinion would be the best place to construct an asylum harbour capable of receiving men-of-war, armed steam-boats, merchant-ships of the largest class, and the trade generally, both outward and homeward bound, accessible at all times of the tide, from the mouth of the Thames to Portsmouth?—Beachy Head.

3078. Where should you say for a second?—Dungeness.

3079. Are you aware of any objection to such a harbour being constructed off Dover?—No, I am not aware of any objection; but I say Dungeness, from its better position, in my opinion.

3080. Could a fleet of merchant-ships always sail from and proceed down Channel from a harbour constructed off Dungeness, with the same wind, and under the same circumstances that they might do from a harbour constructed in Dover Roads?—Yes, I should imagine so.

3081. Are you aware how the extreme point of Dungeness will bear from a harbour constructed off Dungeness?—No; I am not aware exactly of the point of compass, as I do not know how far the breakwater would be carried out, neither could I say in the same way as to Dover.

3082. Are you aware of the course that will carry ships clear from Dover Roads?—Yes; if they steer W.S.W., it will carry them clear.

3083. Are you of opinion that merchant-ships unacquainted with Portland Roads, and seeking shelter there in heavy gales from the westward, will go in to the eastward or the westward of the Shambles?—Under these circumstances they would go in to the eastward of the Shambles.

3084. Are you of opinion that for such ships and vessels a floating light on the Shambles would be necessary as a direction for reaching the anchorage of a refuge harbour?—It would be of very great use indeed, both as a harbour of refuge and roadstead.

3085. (*Sir W. Symonds.*) In reference to a former question, as to the necessity of an inner Channel in the harbour of which you have seen a plan, could or could not vessels sail through that inner passage, and make their voyage down Channel in such weather when they might not be able to fetch out round the passage to the north of the breakwater; for instance, in a wind east or east-north-west?—Yes, under peculiar circumstances.

3086. Are you of opinion that if a harbour of refuge was constructed in Dover Roads, such as has been described for men-of-war steamers, as well as merchant-ships of the largest dimensions, that would or would not be a situation to give protection both to vessels to anchor in the Downs and also in Dungeness?—To a certain extent.

3087. Putting steam-vessels out of the question, would you recommend a pier-harbour to be made for merchant-vessels and men-of-war in a situation like Dover on a very large scale of a very expensive nature, where the holding-ground is not generally good over the space, and where there is said to be a tide of four knots during springs, running across the southern entrance, would a heavily-laden and weakly-manned vessel attempt to get into such a port with the Downs under her lee under all circumstances?—Were I placed in command of a vessel under those circumstances, I would decidedly prefer running into the Downs.

3088. Are not vessels in thick weather cautious with regard to approaching the larger bay between Beachy and Dungeness, on account of the Royal Sovereign Shoal, the Horse of Willington, and the foul ground generally reported to exist there?—Yes.

3089. Do you consider that convoys or straggling merchant-men seeking a port of refuge would venture between the Race of Portland and the Shambles of Portland, not being used to the navigation?—A man could go between the Shambles and the Race of Portland; but I do not think he would come between, as most men not thoroughly acquainted have such a horror of the Race.

3090. Would not the wind be baffling on the high land at Dover for all merchant-vessels comparing it with Dungeness?—Yes; but I never found the wind to be very baffling off Dover.

3091. Might not vessels bound to the eastward fetch round the South Foreland from



Dungeness, when they could not fetch out of the harbour in question off Dover, being in a degree embayed?—One vessel anchored at Dungeness bound to the River Thames, and another off Dover, under similar circumstances; the one in Dover would, I should think, certainly get round the South Foreland before the one from Dungeness.

3092. Suposing a vessel to sail from Dungeness, could not she get into the Downs when a vessel lying in the harbour would not be able to accomplish it?—I understood the question to allude to their both starting at the same time; it is matter of opinion, I think; I cannot take upon myself to say which.

3093. Do not vessels generally consider it necessary to get under weigh when the wind shifts to the eastward of south, as Portland at present exists?—Most vessels that anchor in Portland Roads now are there for shelter from westerly wind; therefore, as soon as the wind gets to the eastward of south, they get under weigh to go down Channel; but vessels lying there for cargoes of stone remain in Portland Roads from whatever quarter the wind comes.

3094. Speaking of the southern or inner passage into the breakwater at Portland, would it not, if of any considerable width, expose the best parts of Portland Roads to the sea, the parts where small vessels generally lie at present?—No; I should think the width in the breakwater would not be of sufficient distance to admit the sea to come home through it: it is astonishing to see how little sea there is close in shore, even now with the wind right in.

3095. (*Chairman.*) Have you ever known any vessels driven on shore in Portland with an easterly wind?—Yes; from their ground-tackle being carried away. I never knew them drive on shore.

3096. Supposing you commanded a squadron of steam-vessels in the Channel in time of war for the protection of the shipping, would you station any of them at Dover to watch the enemy, supposing you had facilities for stationing them, and could station them where you pleased?—Taking everything into consideration, it would be more advisable to have steamers off Dover than it would be at Dungeness. Had I the command of a squadron of steamers, I should be guided to a very great extent by the information I might receive, and many other circumstances combined; as regards Dover or the Downs, or Dungeness, it would be a matter for consideration, under the peculiar circumstances, which of those three places I stationed myself.

3097. Do you consider the Downs so conveniently situate with reference to the opposite ports as Dover?—Yes; very nearly so.

3098. Suppose the force sufficiently large to distribute?—Then I should certainly place some of them there.

3099. Looking at the great anchorages of the Downs and Dungeness where ships anchor constantly in great numbers in stress of weather, what position, as commander of a fleet of steamers, would you take for the best protection of those anchorages looking to both of them?—I must be guided to a great extent by the wind at the time. If I am bound to take up one position, if the anchorage was good, viz., off-shore wind, near about Dover or Folkestone I would be there; but if I had a sufficient force under my orders, I would of course have some steamers at each place.

3100. You stated your preference for Beachy Head, as affording shelter for merchant-ships in the event of a war, would one harbour be sufficient?—No.

3101. Where would you place the second?—At Dungeness.

3102. Are you guided at all by the wish to have a harbour of refuge to the west of Beachy Head by its proximity to Newhaven?—Yes, to a certain extent.

3103. Do not you think that it is much better to have a harbour near a small place, where you might get your supplies of coals and so on?—Yes, taking that into consideration, it is an additional reason why I would place the harbour at the west side of Beachy Head.

3104. You consider that Newhaven, as an auxiliary harbour, would be important?—Yes.

3105. On the same principle, do not you think that Dover Harbour might be of great advantage, by enabling a fleet to obtain any repairs which might be required, and also a supply of provisions and coals, considering that that port is already fortified, which Dungeness is not; that it is a place where you could embark an army at a few hours' notice, and that it is in immediate proximity to a railway; under all these circumstances, which do you prefer, Dungeness or Dover?—Taking into consideration every circumstance, both as regards warfare and mercantile interest with which I am acquainted, I should prefer Dungeness.

[*The Witness withdrew.*]

Adjourned to to-morrow at 12 o'clock.

Commander  
William Crispin,  
R.N.

10th June, 1844.



11th June, 1844.

Admiral Sir T. BYAM MARTIN. in the Chair.

Mr. James Bremner  
and  
Mr. David Bremner.

Mr. James Bremner and Mr. David Bremner, examined.

11th June, 1844.

3106. (To Mr. James Bremner.) You have a plan for constructing a breakwater upon a new principle, for which you have secured a patent?—I have.

3107. Have you a description or specification of the plan?—Yes (*producing the same*).—(Mr. David Bremner.) This is a description of the machine itself.

*The same was read:—*

*“ Description of Bremner’s Patent for erecting Harbour Walls in Deep Water and under the most difficult circumstances.*

“ The patent vessel, as shown, drawing No. 3, is 400 feet long, 100 feet broad, at bottom, 104 feet aloft, and 45 feet deep. When the building is complete for the deepest part of the proposed harbour at Dover, of the above length, 40 feet high, and  $15\frac{1}{4}$  feet in thickness, each section will be 17,400 tons in weight, and float on 16 feet 6 inches depth of water.

“ A. Is the stem and apron piece.

“ B. Is the dead wood.

“ C. Is the bottom part.

“ D. Are frame timbers, all of American oak, white elm 10 inches abroad, moulded 10 inches at bottom and 4 at top, fastened to the floors with a plate of best scrap iron to go under floors and reach 3 feet up\* on each side of frame timbers, the foot of each of which is to be tenoned into floor ends, and to be securely fastened in planking, which is to proceed on outside and inside at once; two screw bolts of iron, inch in diameter, to go through each timber at each tier of planks, and tightly screwed home with nuts on the inside planks.

“ E. Are diagonal braces of 4 inch hard-wood plank, neatly nitched into and driven hard between the timbers, and secured by  $\frac{3}{4}$ -inch bolts, driven through each tier of planks, and well screwed home, throughout the whole.

“ F. Shows the strakes of planking, which is to be of American elm and red pine of great lengths, 4 inches in thickness, and the mode of securing their butts, which are to scarf on at least 2 feet; the shiftings to be particularly attended to; no butts to be nearer than 12 feet to each other.

“ G. The binding strakes, and also stringers, to be 18 by 6 inches, securely bolted with iron screw bolts through all the timbers.

“ H. Are the stanchions.

“ I. Are the rails.

“ K. Is the bow, where 14 feet of space is to be left, and about 10 feet under the upper deck for a patent windlass, for working the chains and anchors from a lower deck, forming a forecastle.

“ L. Is the open space where the wall of harbour is to be built of the requisite dimensions thence deposited in the place appointed.

“ M. Are the deck beams completely crossing vessel, 2 feet 8 inches deep at centre compartment, 8 inches thick, to which the chains for suspending walls are attached in a tripping manner, but very securely; the beams are securely bolted and dowelled to stringers.

“ O. Is a section of inside wall, as built on slip-bottom, and within vessel.

“ P. Are cross beams to be secured by iron knees to the sides.

“ Q. Are diagonal timbers for bracing down bottom, being securely dowelled or coggged into the cross beams, and nitched into the king-post, then securely bolted through it, cross beams and floors, which keeps the patent vessel firmly in shape, while the very great weight of wall, and pressure of water, are upon it.

“ R. Are the diagonal timbers crossing beams, and diagonal timbers Q, to which they are securely bolted and dowelled.

“ S. Are the beams formerly described.

“ T. The king-posts which support the centre of the beams, by means of which the three compartments of patent vessel are securely bound together.

“ U. Are railroads supported from the beams; small portable cranes are worked upon rails from both ends of the patent vessel, and can be projected 30 feet over the ends to take in any stones required.

“ V. Are the chains formerly alluded to, hooked into screw bolts, between which plates of iron, into which they are screwed, are let into the wood.

“ W. Is the stern and planking of same.

“ X. Are cross beams to be sufficiently dowelled into hard-wood planks, and six iron screw bolts  $1\frac{1}{8}$ -inch diameter screwed from inside, and kept in their position, until the passage from place of building to harbour is made, when the bolts will be unscrewed, and beams wedged off; the vessel is then hauled too, stern on as already described. The sections of walls to be bonded as shown, drawing No. 2, by using a mould during the progress of the work, when everything will fit together; bond being left, and a mould of it kept to fit the next section to, so that there can be no difficulty in making as good work as can be done on shore.

“ The bolts are then all unscrewed out of the ends of sleepers, and only left in the plank to keep tight. The water is then let in by screwed sluices; and how soon the slip-bottom is fair upon the foundation, at low water, the sluices are shut; the tripping stoppers which hold the chains are all let go; when the vessel is immediately released, towed off, and as soon as the masonry is ready would do the same again.

“ Two rudders will be necessary, one at each quarter.

\* Also an iron knee.



“Sails could easily be set to assist the steam power in propelling the patent vessel from the place near the quarry to the site of proposed harbour.

“The slip bottom may be made of plate iron.

Mr. James Bremner  
and  
Mr. David Bremner.

“*Estimate of the Expense of Building one of Bremner's Patent Vessels of the dimensions herein described.* 11th June, 1844.

	£.	s.	d.
113,071 cubic feet timber, at 1s. 6d. . . . .	8,480	6	6
359,100 lbs. iron work, at 2½d. . . . .	3,740	12	6
Workmanship, &c., say . . . . .	2,000	0	0
	<hr/>		
	£14,220	19	0

*Slip-bottom.*

	£.	s.	d.
5,946 cube feet timber, at 1s. 6d. . . . .	445	19	0
2,240 lbs. iron work, at 2½d. . . . .	23	6	8
Workmanship, say . . . . .	28	0	0
	<hr/>		
	497	5	8
	<hr/>		
	£14,718	4	8
	<hr/>		

“If used in building for six years the materials would then be worth one-half cost.

“Leaves to the debit of the work done about 7,100*l.* on each patent vessel, four of which are proposed to be used.

“May 25, 1844.”

3108. (*Chairman.*) Is the vessel to be kept in work during the operation?—(Mr. J. Bremner.) Yes.

3109. What does the section you produce represent?—14 feet and a half of length.

3110. Have you put this into practice?—Never, any further than lifting vessels. I lifted last September a vessel, with 500 tons of coal in her, sunk two feet in the beach or sand in Broad Bay, an exposed place in the Highlands of Scotland close to the Butt of Lewis, in 13 fathoms water. I raised her by these means.

3111. What was there at low water?—There was 12 feet left of tide.

3112. How does that illustrate your patent?—It shows the strength of what the beams could do. I had only two baulks of timber across each two ships, and lifted about 1100 tons; they were 14 inches baulk; the vessel was full of sand; the people gave her out as weighing 900 tons, but there was considerably more than that, with the vessel and the coals, and the sand, also the chains used in lifting her.

3113. How many thousand tons do you propose to take in your vessel of 400 feet?—17,400 tons.

3114. What is the breadth of vessel?—100 feet.

3115. What is the depth or perpendicular measurement from the top to the bottom?—45 feet.

3116. This is the shape of the masonry you put in (*on the section*)?—It is.

3117. How do you contrive to keep the vessel upright?—We can balance the thing to a nicety.

3118. Do you mean that there is an equal weight on each side?—Yes, as near as can be. I was a little hurried in making the model, it is to one side somewhat.

3119. How do you counteract that?—We can easily make the one compartment larger than the other.

3120. What water do you suppose she will draw during her voyage?—16 feet and a half.

3121. Your object appears to be to construct your machine at the place where the best stone can be had?—Yes.

3122. And then to have it towed by a steam vessel to the place where it is to be sunk in forming a harbour or a breakwater?—Yes.

3123. Your vessel is, in fact, a caisson, only larger and of a different shape from those commonly used?—Yes, but it is different in many respects; there has been nothing of this kind ever used.

3124. State in what respects it differs from a caisson?—The mode of construction, compartments, and slip bottom in particular.

3125. What is the width or thickness of your proposed cargo at bottom?—25 feet.

3126. What is the thickness at top?—Six feet.

3127. What is the perpendicular height of wall?—40 feet.

3128. What is the slope?—About eight inches to the foot.

3129. Have you ever calculated the displacement by your vessel, so as to be able to make it clear, that she will have sufficient buoyancy for such a cargo?—I have.

3130. When the vessel is in the position for sinking you have some contrivance to let in the water, or as we term it a scuttle, what is that?—By means of sluices to be opened by means of screws.

3131. What do you allow for the weight of the stone?—14 cubic feet to the ton.

3132. What will be the draught when the whole of the masonry is in?—16 feet and a half.

3133. You cannot bring the vessel into a less depth of water than that for sinking the stone?—No.

3134. Then how is the pier within to be completed?—We should build *out* from the shore.



Mr. James Bremner  
and  
Mr. David Bremner.

11th June, 1844.

3135. In what depth of water could you feel confident of sinking your stone with accuracy?—It would be impossible for me to say, but by increasing breadth and height of the vessel we can go as far as from 7 to 10 fathoms.

3136. Supposing one section of the stone to be placed, and you deposit the next section in continuance, can that be done with such nicety as to form the compact masonry you have exhibited?—I am convinced I can do it quite easily.

3137. In what manner?—By making the timber moulds to fit; taking the timber mould and applying that to the section in the after part of the vessel where it was building, then placing two strong rods of iron perpendicularly fixed to the extreme end of section last laid, and stayed with diagonals on its top. Two strong bars of iron forked and with rollers at ends, to run upon the rods described to be fixed at the inner joining of section to be laid. The vessel being moored as shown on accompanying plan, the forked bars are brought exactly upon the rods in which the rollers move in sinking; the joining may thus be made very exactly.

3138. When sinking a section in a depth of seven or eight fathoms, will it be sure to find its true position?—Yes; we take it stern on to the old wall, and as soon as the two come abreast of one another we have a powerful screw to heave them in close, and join them; this is done while it is afloat. We keep it in its position, which there is no difficulty in doing in a calm day, till it comes abreast of the old building; and as soon as the two come abreast of one another, we have several persons on the top to heave them close in; then we fasten them together, and then we open the sluices and let the water in.

3139. Supposing the first section to be right, will the one find its place exactly on the top of the other course?—The lower longitudinal section will show that. I have shown that pretty clearly upon this. This is a map of the soundings at Dover. We begin in this kind of way; the courses all come up, and keep them level.

3140. Are you now describing the ground section?—Yes. Where the greatest declivity is it shelves off in 500 feet from 11 feet to 46 feet at the western pier. The whole may be bound in one solid body.

3141. How many vessels would you have?—Four.

3142. Which would be the cheapest thing—to bring the stone to Dover, which you have selected as your instance, and there construct your masonry, or to construct it 200 miles off, and bring it round?—It depends altogether upon the locality where the stone is. If there is a good quiet harbour where the vessel could be built, I would prefer building it there, and towing it round.

3143. Supposing, with a great strain upon a vessel of that kind, she became leaky?—It is all inside caulking; it is impossible she can become leaky. I will explain what I have done with small six-inch beams laid across vessels with 10 feet sand in the hold. I have taken six-inch spars, and put planks upon them, and some sleepers six inches thick on stranded vessels. And after getting them afloat I have been caught with heavy gales of wind, and rode it out in the Pentland Frith, and many other parts of that coast equally exposed, and brought them into safety without the assistance of steamers, of which we have none.

3144. Can you be secure against the plank giving way and letting in the water?—Yes, quite sure, as the vessel is altogether fastened with iron screw-bolts of large size.

3145. Have you any pumps?—I have powerful pumps provided for.

3146. You mean to say that it is so strongly put together there can be no leak?—Yes, I have provided sufficiently against any leak by caulking inside, and having men overhauling, being three times stronger than any vessel, the cube of every foot in length of eight plankings and bottom gives 135 feet.

3147. Would it not be better, to get rid of all objections, to bring the stone round, and construct it on the spot?—Yes; and in this event the expense of patent vessels might be greatly less than if built to carry the stones from a place much exposed, and at a considerable distance from the proposed harbour.

3148. You think it would be the cheapest plan to bring the vessel round ready built?—Yes, for the freight of the stones would be a continual expense; whereas, if it was built strongly, the whole work might be finished and then brought round, and the work might be carried on, and the same vessels fit to build a dozen harbours afterward.

3149. Do not you think that your vessel would be more manageable and convenient to work if it was only 100 feet or 200 feet rather than 400 feet?—As far as I have seen, with a vessel of 200 feet or 100 feet there is more than double the motion of one with 400 feet in a heavy sea.

3150. Do you calculate on the chances of bad weather, or on the certainty of accomplishing this in fine weather?—I think I am prepared for a pretty good brush. I am fully impressed that I have strength to bear everything up.

3151. You would prefer doing it in a harbour?—I would.

3152. And as near as possible to the spot?—Yes, if the quarry was handy.

3153. Have you ever visited Portland?—No; I am quite a stranger to all that coast.

3154. If you had to construct a harbour at Dover, where should you propose to get your stone?—I should be guided by looking at the chart. If there is good stone at Alderney or Jersey, or anywhere there it would answer best.

3155. Have you had practical experience at sea?—Yes; I have been four times across the Atlantic; the last voyage was in 1805.

3156. Do you think that, if there was a disposition to try your plan, there is any company who would be disposed to join with you in trying it?—I am quite a stranger in the city; and there are so many plans going, that I really cannot say.

3157. If any part of your plan was adopted, would you undertake to become a director and



managing superintendent of it, being paid a sum of money for your trouble?—Certainly; there would be nothing more agreeable to my mind than that.

3158. (*Sir H. Douglas.*) You would build the inner walls in the same way as the outer?—*Mr. James Bremner and Mr. David Bremner.*

Yes.

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3159. With what will you fill up the spaces between?—I propose doing that with chalk blocks at Dover.

3160. You would fill them up with chalk thrown in promiscuously?—Yes, between the two walls.

3161. What is the slope of the inner wall?—Two inches and a-half to the foot.

3162. How do you sink the inner walls?—In the same way as the outer.

3163. You state that the uniform depth is 45 feet?—Yes, of patent vessels.

3164. And the draught of water  $16\frac{1}{2}$  feet?—Yes.

3165. You would begin at low-water mark, and run out the first length of 400 feet?—I would.

3166. Taking Dover Harbour, what depth of water would 400 feet run you into?—I should say 29 feet or 30 feet.

3167. Your first length of breakwater of 400 feet would be sunk on a sloping surface; in that space there would be a difference of 29 feet or 30 feet?—Yes, 1 foot in 14 feet.

3168. How should you manage so that all the foundation of your masonry may be horizontal and the joints vertical?—Before we began to build we should take the exact soundings with rods which we have down on this chart; here is the exact level set down; we begin with the levels at one end and form the foundation; here is the level where it is laid down, and this is the level of high water, (*showing it on the plan.*)

3169. The bottom is formed in one continued slope?—Yes.

3170. How will it be if in a length of 400 feet you meet with a very unequal bottom, so that the difference may be 29 feet at one point, and at another point a still greater inequality?—We take small handy materials, and get sounding rods, and iron rakes, and rake it over and make it smooth and level.

3171. You make the rock smooth?—Yes.

3172. The unity of the work depends upon the consistency of the bottom, because if any part there is soft sand, there will be under washing, and dislocation of the masonry; how will you provide against that?—There will be stones thrown down on the outside, at the foot of the wall after it is sunk.

3173. Suppose a part presses on rock and a part on sand?—The precautions I take completely guard against that.

3174. Do not you think that there will be an under washing where there is sand?—There will be stone thrown in to prevent that, and whenever we find anything soft we shall throw in rubble.

3175. You prepare the ground beforehand with a diving-bell?—No, that is not necessary.

3176. With respect to the construction, its admirable arrangement provides for the strength of the beam, and the lateral strength of the section, but do you not apprehend that this long vessel of 400 feet in length, of which that you have produced is a section, not having either keel or keelson the removing her would create a great danger of breaking her back?—No; she has eight thicknesses of four or five-inch plank; eight coatings in fact in place of four, which is enough for any ship; the height is in very good proportion, and it is all vertical timbers; her strength is much greater in proportion than that of any other ship.

3177. You mean to say that you rely upon the strength of your plank?—Yes; and my diagonal fastenings below timbers.

3178. You have no sleepers?—No, they would be of no use.

3179. What would be the objection to your caissons being made in lengths much less than 400 feet?—None whatever, but that they will work much easier at the full length and be much more easily commanded; the greater the length the easier they will work.

3180. (*Capt. Fisher.*) You state that you have had experience as a seaman, and have been across the Atlantic several times?—I have.

3181. From your experience as a seaman are you not of opinion that very extreme risk would be incurred in navigating a vessel or a caisson of the description you propose, namely, 400 feet long, 100 feet in width, drawing  $16\frac{1}{2}$  feet water, and carrying 17,000 tons of material for any distance, and that it would be much preferable in every view that this caisson should be constructed as near as possible where the breakwater is to be formed?—After having given the most mature consideration in my power to this for the past two months, and considering the power of steam, and that we shall be able to get two steamers, or even three, if necessary, I do really think it will be perfectly safe in a length of 400 feet; but, still I perfectly agree that it cannot be without a risk in case it should be attacked on its voyage with a heavy gale of wind. In the summer months this would not be likely to occur.

3182. Have you had any experience of carrying out materials in the way you propose?—Yes.

3183. State on what scale?—About 40 or 50 tons between two old boats which I had bought for 30s. a piece.

3184. (*Mr. Walker.*) Are you not aware that the dangerous state in which Westminster Bridge has long been, and which has occasioned, in some years, the outlay of enormous sums of money, is in consequence of the original builder having constructed the piers of that bridge in caissons, that they were taken out and sunk on the sand without any under piling, and that the under washing of that sand occasioned the destruction of one arch, and is the main cause of the enormous outlay now going on on that bridge?—So I have heard.

3185. Is not the system of using floating caissons, such as you propose for laying foundations of masonry of any kind in water, generally abandoned by all civil engineers?—There is



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no doubt that the strength of the run of water might cause a defect in Westminster Bridge, where there is such a rapid current of water; we have not that inconvenience to contend with, and then the continuation of such a long line, and the weighty materials thrown on outside, and the hearting on inside will be a guard against any wash whatever. I certainly do think there will be no risk whatever; with the heaviest buildings there are there is more or less timber about them.—(Mr. David Bremner.) I would beg to suggest that the case of a bridge, resting upon small piers, and of a continuous wall like this, are not exactly parallel; the superstructure of the one rests on a very small surface, and the arches being altogether above water throw a very considerable weight on foundation, besides the vibration caused by carriages, waggons, &c., continually passing over. It would not be so with sea walls, resting on a large area of foundation and not subject to vibration of any kind, and the walls battering, all their weight is not laid on their foundations.

3186. Still there could be no under washing without a dislocation of the unity of the masonry?—No, if it yielded to the pressure of the water against it; but, in speaking of Westminster Bridge, the greatest amount of mischief did not occur till the water was pumped out of the coffer-dam.

3187. You refer to the late injury, but the question refers to the original injury, to the washing of the sand?—There is a difference there, certainly; the pier here would have a constant pressure against it, and in the depth of 40 feet of water I do not know that, if done in the manner here proposed with rubble below and outside the bottom of caisson for the pier of bridge alluded to, any such accident would have occurred.

3188. Do you not consider that the vessel would rest on a shaky foundation with two feet depth of timber between the sunk wall deposited and the bottom?—(Mr. Bremner.) That I propose getting filled with concrete between the frame and the bottom, but I should remark that it would be only about six inches in depth of timber.

3189. When should you get that done?—When we are building the wall platform, or slip bottom.

3190. Do you propose to have a bottom of wood?—Yes; or of iron under the wooden beams screwed to with bolts, and only leaving the iron plates between masonry and foundation.

3191. How many inches of wood in thickness?—Seven inches for sleepers.

3192. Suppose, in sinking the vessel, the extremes of the fabric on each side took the ground before the centre, from the unevenness of the ground or otherwise, what would be the consequence in your opinion?—The ground is levelled before the work comes there.

3193. Unless such an unwieldy vessel can be placed steadily and evenly across strong tides and winds, will not that which is deposited be liable to form a zigzag or mis-shapen wall consisting of so many joints?—The vessel is so firmly built there is no danger of that; there must be proper winches steadying her; it is impossible with proper care that that can be the case; we must have plenty of winches provided to guard against any danger of that kind.

3194. (Sir W. Symonds.) Have you ever calculated what sized chain, and what weight of anchor would be necessary to hold a vessel carrying a weight of 17,400 tons, besides her own gravity, in the event of its being necessary to anchor the vessel?—I have calculated that; it is not so much as may be at first supposed; the vessel having no masts or spars, she does not require half the weight of anchor of other vessels in proportion to her size.

3195. (Lt.-Col. Alderson.) In the event of your making your caissons in smaller lengths, could not you make a very considerable use of the concrete for the formation of your construction?—I am perfectly aware that the concrete would form a most important part.

3196. So that, sinking masses of concrete, you might afterwards face them very easily down, and slope them with great masses of stone?—You can never depend on any kind of stone for such constructions unless they are built in proper form; I never could get them to answer without that.

3197. You have never built any breakwater yourself?—I have built not fewer than 10 in most exposed parts; and founded in 8 and 10 feet water at low spring ebb tides, and employed stones of 40 to 50 tons, which brought it to the level of low water in one height; all which stand most secure. Of these my son superintended six breakwaters.

3198. Is there any other paper you wish to produce?—Yes, I have prepared a statement, which I beg permission to read.

*The same was read as follows:—*

*“ To Admiral Sir Thomas Byam Martin, G.C.B., Chairman of the Commission for Harbours of Refuge.*

*“ SIR,*

*“ When I was honoured, on the 3rd instant, with your desire that I should lay before and explain to you and others of the Commission appointed to survey the south-eastern coast, my plan and models of the same, for building sea-walls in deep water and in the most exposed situations, now secured to me by Her Majesty’s letters patent, you requested me to report upon the mode and expense of executing the proposed Harbour of Refuge at Dover, according to the principles of my invention.*

*“ To enable me to comply with this request, in addition to having previously been at Dover, I have obtained a knowledge of the extent and position of the work contemplated, and the particulars of the drawings accompanying, from a lithograph plan, on which the soundings, the nature of the bottom, and the line of the coast adjacent to the proposed harbour are laid down, which, along with a Report by a Commission to the Lords of the Admiralty, was ordered by the House of Commons to be printed June 5, 1840.*

*“ Of the necessity, importance, or effect of having such a harbour as that proposed at Dover, no opinion of mine is required; this part of the subject has very happily fallen into abler hands.*

*“ I will, therefore, refer briefly—1st, to the description; 2nd, to the construction; and, 3rd, to the upholding of the work, according to my ideas.*



*“ Description of Building Materials.*

“ The outer easings, or the sea and inner walls, shall be of sound and durable stone of large sizes, built header and stretcher alternately in the best lime mortar, close jointed, fair dressed, and set in the manner shown on the accompanying transverse sections, due attention being paid to the bond of every stone; bars of iron 3 inches by 1 inch to be sunk into the courses longitudinally, and vertical bolts 1 inch diameter to be bored for and driven home at intervals of 3 feet, in the way represented on sections; iron tie-bars, 3 inches by 1 inch, to be sunk and fixed transversely into the courses of walls; to these, tie-beams and chains to be fixed to connect both walls securely together. Sections of the sea and inner walls, in lengths of several hundred feet, to be solidly bedded upon the bottom. The interior filling in, or hearting, for which chalk blocks will be sufficient, to be put in promiscuously to the level of low water, and gravel to be used to fill in the interstices in considerable quantities, at suitable heights as the hearting progresses; the same to be continued at every four feet of height above low water, to form a compact and firm mass. The stones of the sea-wall to be entirely built with lime-mortar; but the inside wall to low water only. Tie-beams and chains to be continued above in the same way as under low water.

“ The platform or roadway on the top to be paved with stones of sound quality, not less than 8 inches thick, well dressed, set on edge upon a bed of gravel, good lengths, and 18 inches deep. The whole to be wedged with fir wedges in the most firm manner.

*“ The Construction of the Work.*

“ The work under water, so far as the construction of the walls is concerned, forms the subject-matter of my patent; and any description of how it is proposed to be done will be understood to bear directly on my invention. The walls I propose building in such lengths, varying from 100 to 400 feet in length, as may best answer the bottom. These sections to be built near the quarry, floated off, and sunk in their respective places by means of the full application of my patent. Previous to this, the ground which is to form the foundation is to be examined carefully and sounded with rods, and any inequalities to be made up with small stones of hard quality and irregular shape thrown on top of the place; large iron raking machines worked from barges, then to pass over the surface in all directions, to consolidate and straighten the surface properly.

“ Drawings also accompany this Report, showing the mode and principles of construction of the patent vessels (the expense of which has been estimated) to carry out and deposit the under-water walls—the most important and difficult feature of any low-water harbour.

“ The unfinished ends of walls to be most carefully closed in, as shown on an accompanying drawing, to prevent any breach by the sea during storms upon the hearting, until the ends are permanently built up similar to the sides.

“ At each joining of the various portions of the walls, to which great attention will be paid, bond to be made as shown on the elevation of wall, the one end fitting exactly into the other; long iron bolts to go obliquely from one section into the other, so as to fix and unite them properly together. All the bolting and iron work to be laid flush in Parker’s cement, with which the face-joints of the walls are to be pointed.

“ The railways and machinery for carrying on and building the materials to be set upon a continuous line of framing, of the description shown on transverse sections. Should it be found necessary, for the sake of dispatch, locomotive steam power to be used for bringing in the waggons.

“ Hard stones of various sizes to be put down promiscuously, so as to lay in a body at the foot of the sea-wall for its entire length.

*“ Upholding of the Work.*

“ With the excellence of the quality and mode of building, and the substance of the proposed walls (each section deposited being like a solid stone of its own dimensions), and their being so firmly bound and tied transversely together, no apprehension need exist of the perfect strength and solidity of the work.

“ The slope of the proposed sea-wall is designed with especial care to combine a most firm wall, with offering but little resistance to the force of the sea in stormy weather; the inclination being such as to give the upper portion of the wall a considerable weight upon the lower part, and so preventing the action of the sea from shaking out the stones, which would be the case in a perpendicular wall; or their being torn out, as is often the case on too flat a slope; the waves acting with concussive force *against* the one, and with their whole weight and velocity *upon* the other.

*“ Conclusion.*

“ The scheme I have the honour to propose for the execution of the work at Dover consists of building large sections of sea-walls near to the quarry, in some place having tolerably smooth water and an even bottom, on which the platforms (called slip-bottoms in my patent) rest; on each of these the masonry may be built at all seasons of the year. Through and beside the masonry strong chains are to be fixed. The patent vessel for the buoying the whole out, is, after the completion of the masonry, taken over and attached thereto by the chains, and also screw bolts at low water. With the rising tide the whole floats may be towed off by a steamer, and by the aid of sails on the patent vessel itself (it may be for some hundred of miles), to the site of buildings; care being taken to have powerful pumping gear, even although the vessel is tightened on the inside planking where men see and can stop, at the time, any leaks that may occur.

“ The desired place arrived at, the section of wall to be moored exactly over its berth; at low water, if it should not ground, the patent vessel to be allowed to fill very gradually with water, by means of a screwed sluice at each end of each compartment, by which means the section of the wall may be sunk in any way necessary, until it is known that the wall rests firmly on the bottom, when the screw bolts are so far unscrewed as to be clear of the slip-bottom beams, the chains are then detached, and the vessel is relieved and floats clear, is pumped out, towed or sailed back and fixed on to another section of the wall without loss of time, returns with and deposits it, and so on, while the good weather lasts.

“ This carries the walls a little above the level of low water, when, after being secured and bound in the manner aforesaid, the hearting may be inserted; but it shall in no case go in advance of the building, or go in at all until the walls are perfectly secured together.

“ A strong feeling may exist as to whether anything can be constructed sufficient to float and remove such a weight of stone as will be necessary for the purpose intended. There can be no doubt of this

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that when old crazy vessels carry heavy cargoes in *bulk*, such as coal, lime, stones, &c., with very bad weather, a vessel of peculiarly strong build can, with comparative ease, carry a very great weight, which is so firmly united as to present one *unbroken* whole, which weight is equally distributed over its whole length.

“ A trial of the process, however, will dispel all fears of this kind, and prove the economy of that system by which piers may be built without lighterage or freight of any description, which would otherwise form an important part of the expense necessary to construct a harbour at Dover.

“ It may be naturally expected that the description of a scheme in the process of being patented, written by the patentee himself, will contain statements so flattering that they will never be realised. But here I must take the liberty to mention that the same influence that has induced me to apply for and be at the expense of a patent, also induces me to recommend the adoption of my views at Dover, namely, an experience in harbour engineering and building in the most exposed situations in the kingdom of 38 years standing: thus much for practical knowledge of harbours and harbour building. As to ship-building, I have taken off stranded vessels in the most damaged state from most exposed parts of the coast to be repaired; built and repaired vessels of very large burthen: in doing all which my experience has now been extended to nearly half a century. This enables me to know, and, indeed, led me to the design of the patent vessels, what should be done to strengthen them best, and what they are capable of lifting. But to return to this digression.

“ Even at Plymouth, where the breakwater is only one half the length, or depth, of that proposed at Dover, and where the hearting used is *good stone*, the cost of execution has been very far beyond what the work could have been more efficiently done for, through the flatness of the slope made by the sea upon materials at first promiscuously tumbled in. And what is to be expected of the soft chalk blocks at Dover, intended to form the body of the breakwater there? Let the same principle of forming the interior, getting it consolidated by the action of the sea, and raising upon it machinery for completing the outer casings at Dover, and it will be entirely ruined as a roadstead or harbour of refuge, from the violence of the sea demolishing and strewing all over the bay the chalk blocks thus thrown in.

“ But a very strong proof against the fitness of chalk being exposed to the sea, for any period of time, existed at Dover itself, with an extensive breakwater, built in the time of Henry VIII., which was demolished before it could be completed.

“ If placed within lime-built stone walls, with a mixture of flinty gravel, however, there can be no doubt of the sufficiency of chalk as a hearting material.

“ The question might be asked how are the walls to be carried out *before* the hearting by diving-bells, or any apparatus ever yet used? With even dry-built stone walls, not bound with long bars of iron, or bolts at all, it is barely possible to be done, and would take rather more than half a century to do, even if the sea should make no ravages on the work.

“ But in the strong and complete manner here specified, of doing the work, or, as the nature of the situation, and hearting material would require, would be found utterly impracticable, with these means.

“ Contrast with this the short space of six years of ordinarily good weather, which would suffice to complete the whole work in a more substantial manner and at a cost very much less, than by any other way.

“ It was bare necessity that led to the discovery of the new principle for building in deep water here explained.

“ In executing harbours in most exposed situations it has often fallen to my lot to rebuild and execute works that others had failed to finish; and my attention was thereby called to design and erect very powerful machinery, placed above the reach of the sea, and which gave great dispatch during the short time that favourable weather lasted. At Pulteney Town Harbour, the property of the British Fisheries Society, where I engaged in a most serious undertaking in extending a breakwater by contract, the bay is most exposed, and notwithstanding the excellent machinery there erected, one tide proved almost fatal to the work, a great part of which was demolished, and the bulk of the stones, which are very heavy, and of excellent quality, were carried away a distance of 400 yards, and some of them deposited under water in the entrance, to its great injury. With the utmost difficulty the work was finished next year.

“ I was lately applied to for a design to extend that harbour into a still more exposed part of the bay, and much deeper water, at the passing of the Bill, for which work I now attend as engineer.

“ Knowing well from past experience there, that unless the piers were erected, each in one season, out of three fathoms water, spring ebbs, the whole would certainly be driven down, I came to invent that without which no machinery ever used could avail to finish the proposed piers,—neither of them exceeding 600 feet in length,—in one year each, failing which they must inevitably be driven down.

“ What is here said of myself will be accounted for by the nature of the description, and the invention described.

“ The accompanying drawings, four in number, are necessary to show the work as finished, and carrying on, one drawing referring entirely to the patent vessels.

“ I made a detailed estimate of the cost of the contemplated harbour at Dover, founded on facts obtained from good authority in London; and it is sent herewith. The cost of the work, if done as shown on transverse sections, and as herein described, would be far under the estimate of the Commission of 1840, while the work would be far more substantially and expeditiously completed than by any other mode of building ever used.

“ All the information I can give, you are perfectly welcome to, free of any charge; but to visit and inspect the various quarries that may be most suitable for Dover,—on which alone the prices for an exact estimate could be ascertained, without my travelling expenses being allowed me,—I am not prepared to do.

“ Finally, I leave the matter in the hands of the honourable the Commissioners, with this lengthened paper, in the confident hope that in due time it will receive a favourable consideration, which I only look for on the merits of my invention.

“ I have the honour to be, &c.,

“ JAMES BREMNER.”

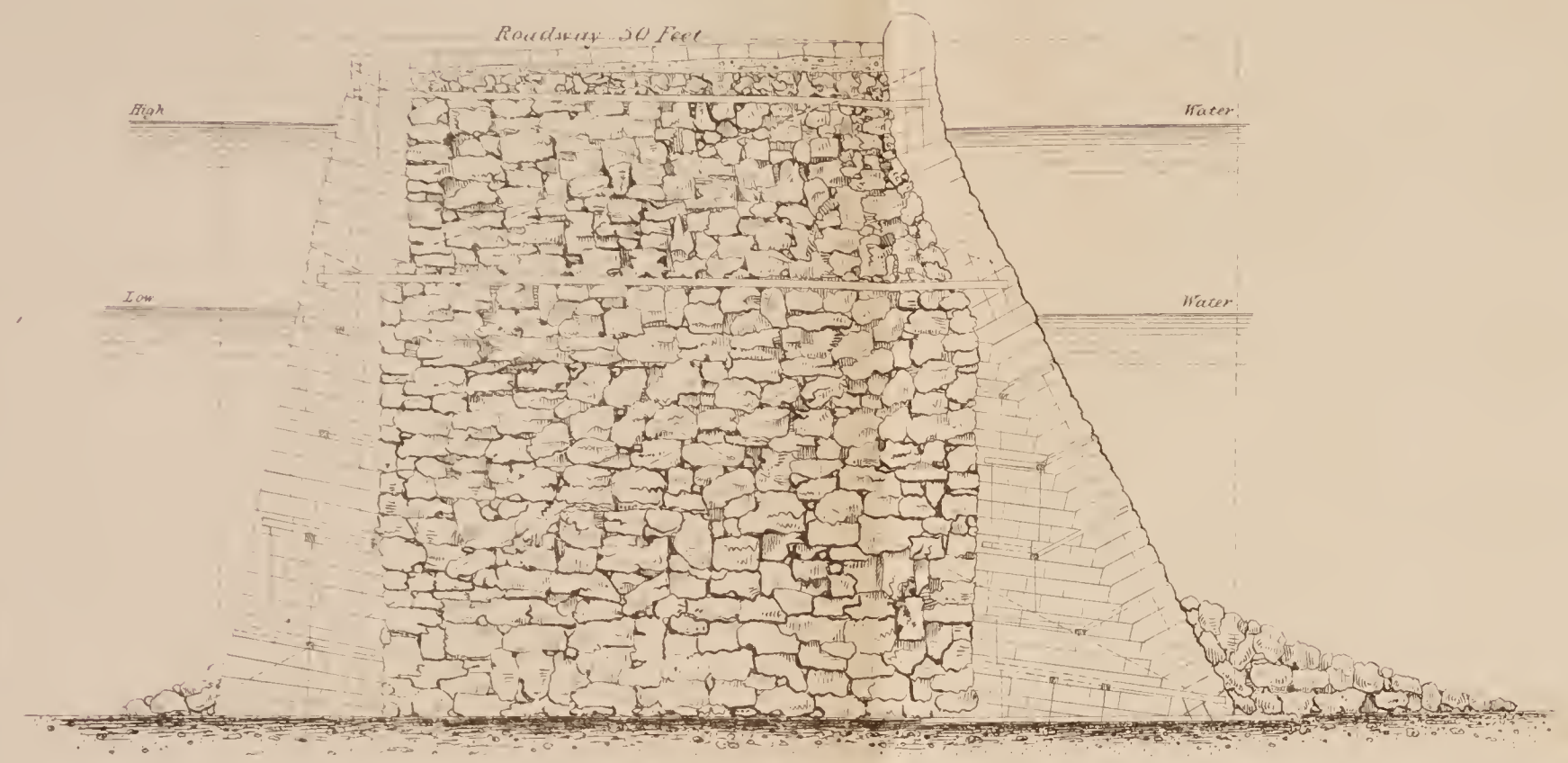
“ 4, Northumberland Court,  
London, May 25, 1844.



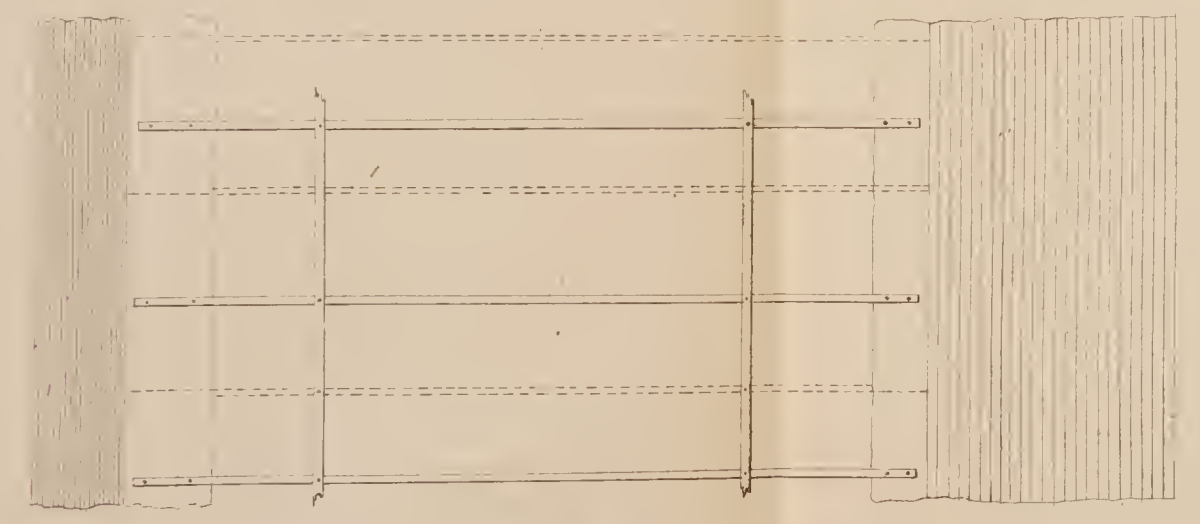
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PROPOSAL FOR BUILDING HARBOURS OF REFUGE.  
REFERRED TO IN A REPORT BY JAMES BREMNER 1844.

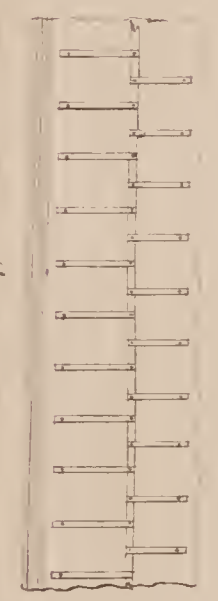
SECTION OF PROPOSED PIER.



Horizontal section of Walls shewing mode of Tying.

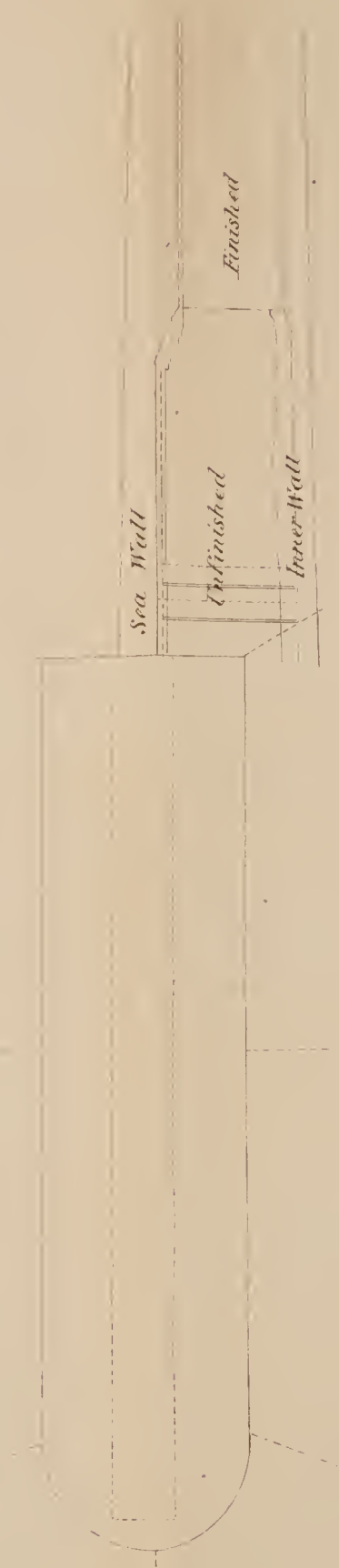


Horizontal section of a wall shewing mode of binding by Timbers

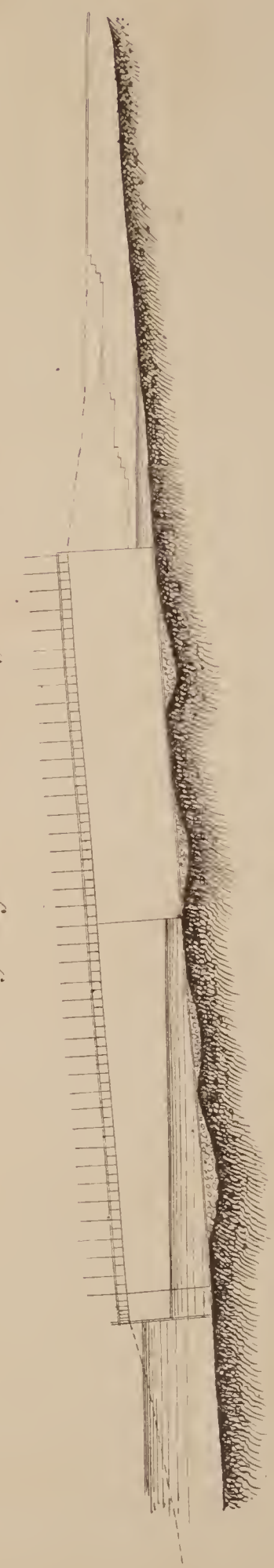


10 20 30 40 50 60 70 80 90 100 Feet

PLAN OF VESSEL AS DEPOSITING A SECTION OF SEA WALL.



Section showing Vessel laying section of Wall on sloping bottom originally-uneven, made straight as described.



100 200 300 400 Feet



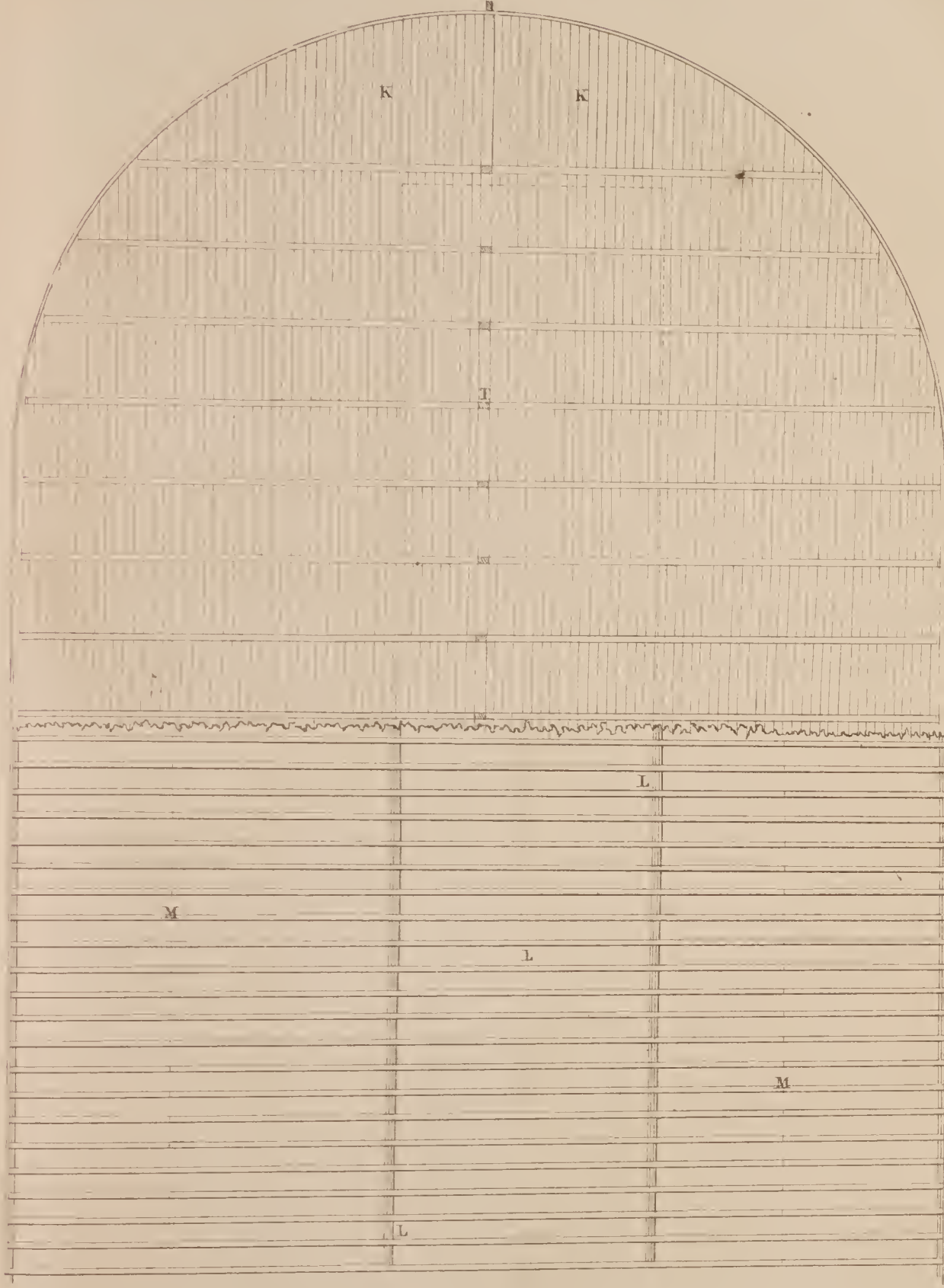




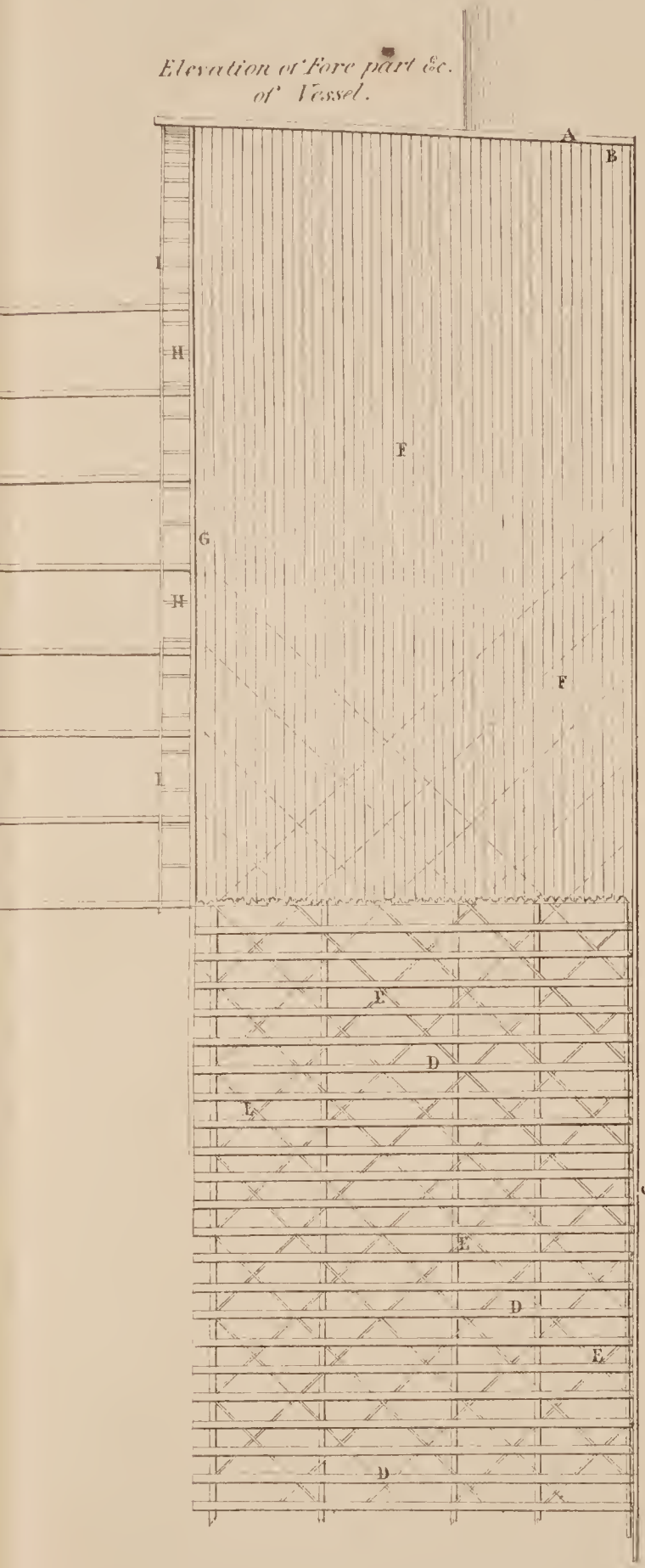
See page 634 in Evidence

PROPOSAL FOR BUILDING HARBOURS OF REFUGE.  
REFERRED TO IN A REPORT BY JAMES BREMNER 1844.

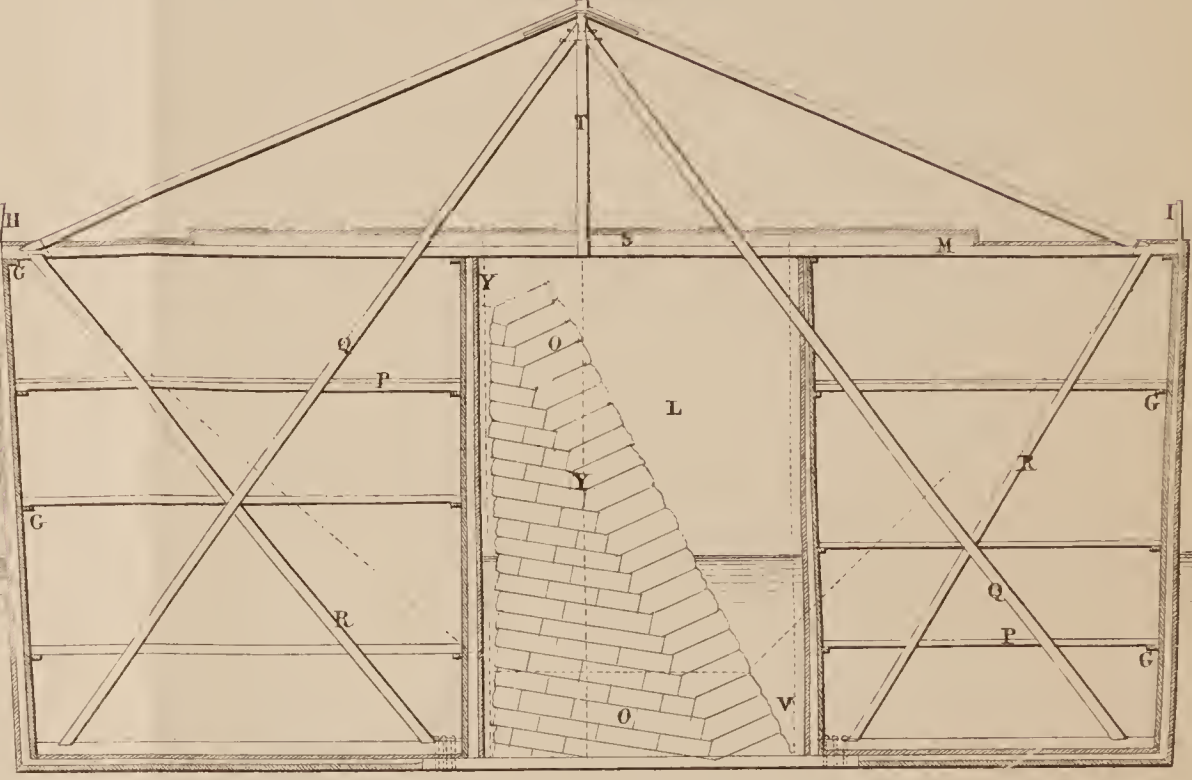
Plan shewing portion of Fore part, trussed beams, deck beams compartments &c. of Vessel.



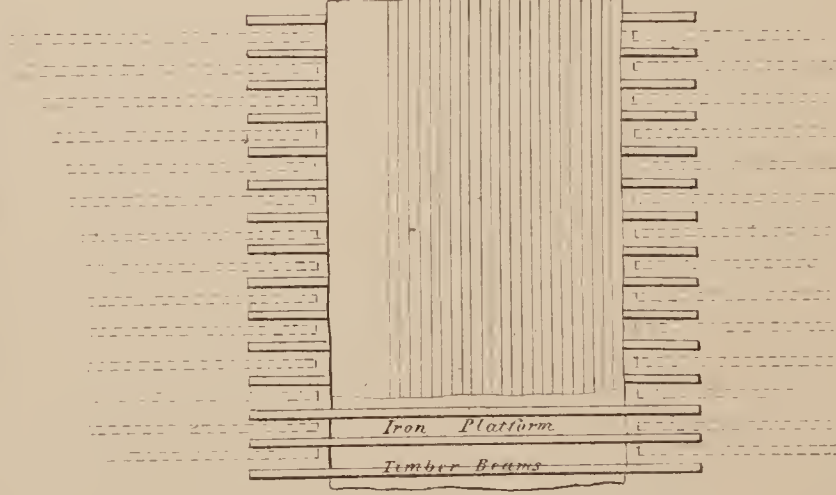
Elevation of Fore part &c. of Vessel.



Transverse Section of Vessel Sea wall, &c. afloat.



Plan of Sea wall, Ship bottom, and position of Vessel's floors.



10 20 30 40 50 60 70 80 90 100 Feet







ESTIMATE of the Probable Expense of Building a Harbour of Refuge at Dover, according to a Plan, published by Order of the House of Commons, and agreeably to Cross Sections, proposed by JAMES BREMNER, in connection with his Marine Patent: made out, as desired at the Prices he has been building for; and at which the Extension of Pulteney Town Harbour into deep water is estimated.

Mr. James Bremner  
and  
Mr. David Bremner.  
11th June, 1844.

References.		Dimensions.	STONE WORK.			£.	s.	d.	£.	s.	d.
Sea Wall	. under low water	7950.0 × 15.0 × 40.0 =	4,770,000								
,,	. above low water	7950.0 × 6.0 × 33.0 =	1,574,100								
Inner Wall	. under low water	7950.0 × 14.0 × 40.0 =	4,452,000								
,,	. above low water	7950.0 × 10.0 × 22.0 =	1,749,000								
			12,545,100	cube feet at 9d.		470,441	5	0			
Hearting	. under low water	7950.0 × 84.0 × 40.0 =	26,712,000								
,,	. above low water	7950.0 × 74.0 × 22.0 =	12,942,600								
			39,654,600	cube feet ÷ 27	}	293,737	12	0			
			=1,468,688	cube yds. at 4s.							
Sea Wall,	}	under low water	1550.0 × 10.0 × 15.0 =	232,500							
East Pier		above low water	1550.0 × 6.0 × 33.0 =	306,900							
Inner Wall,	}	under low water	1550.0 × 10.0 × 15.0 =	232,500							
East Pier		above low water	1550.0 × 10.0 × 22.0 =	341,000							
			1,112,900	cube feet at 9d.		41,733	15	0			
Hearting, East Pier			1550.0 × 74.0 × 38.0 =	4,358,600	cube feet ÷ 27	}	32,285	16	0		
				=161,429	cube yds. at 4s.						
Sea Wall,	}	under low water	560.0 × 9.0 × 8.0 =	40,320							
West Pier		above low water	560.0 × 6.0 × 33.0 =	110,880							
Inner Wall,	}	under low water	560.0 × 11.0 × 8.0 =	49,280							
West Pier		above low water	560.0 × 9.0 × 22.0 =	110,880							
			311,360	cube feet at 9d.		11,676	0	0			
Hearting, West Pier			560.0 × 74.0 × 27.0 =	1,118,880	cube feet ÷ 27	}	88	0	0		
				=41,440	cube yds. at 4s.						
Roadway Pitching.			10,060.0 × 67.0 =	674,020	super. feet ÷ 9	}	18,722	15	0		
				=74,891	super. yds. at 5s.						
									876,885	3	0

		TIMBER WORK.					
Tye Beams	No. 1590 × 88.0 × 1.0 × 0.6 =	69,960					
,,	No. 203 × 88.0 × 1.0 × 0.6 =	8,932					
Uprights	No. 3710 × 68.0 × 0.6 × 0.6 =	63,070					
,,	No. 581 × 42.0 × 0.6 × 0.6 =	6,100					
,,	No. 259 × 32.0 × 0.6 × 0.6 =	2,072					
Diagonal Braces	No. 4020 × 31.0 × 0.6 × 0.3 =	15,577					
Top Beams	No. 670 × 88.0 × 1.0 × 0.6 =	29,480					
			195,191 cube feet at 1s. 4d.	13,012	14	8	
Top Planking, 2 inches thick	10,060.0 × 70.0 =	704,200 superficial feet at 3d.	8,802	10	0		
				21,815	4	8	

		IRON WORK.					
Longitudinal Flat Bars	47,700.0 × 0.3 × 0.1 =	477,000					
Transverse Flat Bars	56,710.0 × 0.3 × 0.1 =	567,100					
Perpendicular Bolting	400,150.0 × 0.1 diam. =	1,050,393					
,,	70,420.0 × 0.1 diam. =	184,852					
			2,279,345 lbs. = 1017½ tons at £10.	10,175	0	0	
Chains of all descriptions, second hand, good quality	3720 tons at £8.	29,760	0	0	39,935	0	0
Number Four of Bremner's Patent Vessels for Building Harbour Walls in Deep Water, each estimated at £14,220.		56,880	0	0			
Number Forty-five Slip-Bottoms, each estimated at £497		22,365	0	0	79,245	0	0
Roman Cement, 1000 casks at 10s.					500	0	0
					1,018,380	7	8
Add for Contingencies, 10 per Cent.					101,838	0	9
					£1,120,218	8	5

May 25, 1844.

E. E. JAMES BREMNER.

Taking the masonry, which is the only part not fully ascertained, at 1s. 3d., instead of 9d. per cube foot, as at Pulteney Town Harbour, with 10 per cent. on the difference, would make the full amount £1,552,370.

3199. (*Chairman.*) Are you aware of Mr. Cubitt's plan for constructing a breakwater at Dover?—I am not.
3200. (*Lt.-Col. Alderson.*) Notwithstanding the strong trussed framing by which the chamber on each side of the centre chamber is supported, do you think that, in case of a heavy sea, the connexion between the bottom, which is to be afterwards detached, and the fixed bottoms, is such as to prevent any danger of the vessel leaking at the connexion between the two?—No; I think there is no danger of that.
3201. You think that that is prevented by the strength of the screws which connect the parts together?—Yes; there are 16 feet of shiftings. The transverse tye-chains go right through the walls to the extreme height of the vessel's gunwales, which keep up the weight, as well as heaving down and together both sides of the vessel at the same time.
3202. Is there sufficient strength to keep the extreme ends in the direction of the width



Mr. James Bremner  
and  
Mr. David Bremner.  
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drawn from the timber trussing. Do you depend upon that or the chains?—Principally upon the chains; but it all helps considerably, and the screwing keeps the whole together.

3203. Have the timber trusses which terminate at the king-posts any powerful resistance in keeping the two extreme ends?—They have a great deal, by means of this connexion, and being firmly bolted with the timbers they cross.

3204. In your model you show a projection outside the section of the stone; what does that mean?—They are beams of 14 inches running longitudinally. There are beams from end to end, bolted through the mass of stone, and down through the slip bottom.

3205. They are crossed by what?—By other pieces bolted to them, so that the whole is bolted into one mass; so that, by iron bolts crossing it in various directions, the stone-work forms one connected mass.

3206. Supposing there be no sand over the chalk rock where you deposit your caissons, do not you apprehend danger from the worm attacking your caisson's bottom?—There would certainly be some danger of that, but we should fill in between the slip bottom on both sides with concrete before the building goes on; besides, it may be made of plate iron entirely, and thus provide a mass outside which will protect it, and the tye-chains in the heart connect the walls together; so that I cannot imagine any great danger from that source.

3207. How low under low water have you known the worm to affect timber?—Very low indeed; 19 or 20 feet, or more than that.

3208. Have you known it at 40 feet?—I do not remember any case so low as 40 feet which has come under my notice. I have known ships drawing 14 feet with their bottoms affected when they have come across the Atlantic, before the coppering was introduced.

3209. Supposing that this should not be eaten by the worm, still it will perish in time?—Yes; but before that time the work will have got properly consolidated into a solid body.

3210. Have you known fresh timber, when sunk and kept constantly under the water, perish?—No, I never have. In the year 1807 I took to pieces the “Centurion,” which had been round the world with Captain Cook: she must of course have been very old, but I could see no decay in her timbers in the bottom.

3211. Do you apprehend no danger in case of this being deposited on soft sand?—The pressure being downwards where the building is, of course that would be a complete preventive to the escape of the sand, and the mass of the materials on the outside would have its effect. The sinking does not take place in a sandy bottom unless the sand escapes.

3212. What timber stands best under water?—I dare say there is nothing better than elm or Scots beech, or birch of any kind.

3213. Which is best?—I think there is nothing better than English elm or Scotch beech.

[*The Witness withdrew.*]

Jas. Steward, Esq.

James Steward, Esq., examined.

3214. (*Chairman.*) Where do you reside?—At Dover.

3215. Have you suggested any plan of a breakwater at Dover?—Not of a breakwater, but of piers to enclose the bay, with the exception of a capacious entrance at about south-east.

3216. Into what depth of water do you go?—Into six fathoms at low water.

3217. Enclosing what area?—450 acres.

3218. Do you not think that two entrances would be desirable—an eastern entrance, as well as the one you propose?—With respect to an eastern entrance my own mind is undecided; it must be admitted that an eastern entrance would allow of sea-entering, that would make the harbour more turbulent, and perhaps in time admit the shingle; while on the other hand it would possess certain advantages, especially considering that the ground which I propose to enclose is a roadstead now, and that a very considerable number of vessels use it with the wind at north, sailing from it when the wind comes round; hence, if they are occupying the ground in the eastern part of the harbour, when the wind comes round to the westward they will necessarily have to warp or tack to the westward in order to get out, with an entrance only at south-east; but if there were a small eastern entrance in about four fathoms, vessels bound to the northward would pass out of the harbour with greater facility when the wind was fair for them to sail after having been wind-bound.

3219. What is the mode you propose for constructing your work?—It is fully described in my printed report, from which I will, with permission, read an extract, which will be more concise, probably, than any answer I could give. Referring you to plan No. 2, it will be observed the proposed piers enclose upwards of 450 acres, the harbour being in length nearly a mile and a half, and the distance of its entrance from the shore 1100 yards. Of its two piers, the western pier is in length 1630 yards, its width at top 32 feet, and its height, exclusive of parapet, 10 feet above high-water level, and the eastern pier, in length 1330 yards, of the same width at top and height as the western pier,\* leaving an entrance of 1000 feet at about south-east, a point of the compass from which, it being immediately across Channel, Dover Bay is known to be least assailed by winds and seas.

3220. Is not that a wide entrance?—I have left a very capacious entrance in consequence of the difficulty which otherwise might occur from vessels having to work in and out at one entrance. I think there would be no objection to so wide an entrance, as there is very little sea in Dover Bay with the wind at south-east.

3221. What slope do you give to your sea-front?—The proposed work not being simply a breakwater, but piers, the inclination of their sides is 75 degrees, as explained by one of my

\* Should it be thought that the width of the eastern pier may, not having wharfs, &c., be less than the western pier, such an alteration in the plan would of course materially lessen the stated amount of the cost of the proposed work.



plans and sections, which I beg to produce. (*The Witness produced several plans and sections, Nos. 1, 2, 3, 4, and 5.*) The western pier is projected from the land from Cheeseman's Head, (which is 170 yards to the westward of the entrance of the present harbour,) and is carried out upon such a principle as that the waves of the prevailing winds, from south to south-west, should impinge upon the western side of this pier to drive any accumulations of shingle there to take place, not round the pier, but to the shore, and so oblige this hitherto intractable enemy to a harbour at Dover to deposit itself in Haycliffe Bay, (on the plan styled prospectively Shingle Bay,) the whole of which must become filled up before deposits of arrested travelling shingle there could threaten to pass round the side of this pier to the entrance of the new harbour: for it is very important that it should be here remarked, that the travelling shingle *is alone propelled by the wave*, at the acute angle which the wave forms with the shore, or with projections or deposits extending from the shore, *and that it never moves under water*: so that, in order to their being any danger of accumulations of shingle against the western pier in time reaching the entrance of the proposed harbour, the shore of Haycliffe, or Shingle Bay, must first become gradually advanced by such accumulations a quarter of a mile seaward, or even more! which, looking at the depth of water in that Bay, would take many centuries: a fact perfectly apparent to persons well acquainted with the phenomenon of the travelling shingle and its effects, and one which affords an incontrovertible answer to all difficulties which have been offered on this subject.

Jas. Steward, Esq.

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Of the eastern pier I have only to remark, that it would be carried out from the shore at a part (the East Cliff) where its principal material, blocks of the hardest chalk, would be found immediately at hand; and that hence, and from the sea-bottom here being very favourable to contemplated operations, it would be reasonably and expeditiously erected. The depth of water in the proposed harbour will be observed, from the soundings marked on this plan in feet at low water of spring tides (taken from the survey of Captain Bullock, R. N.,) to be, at 400 yards from the shore, two fathoms, and at 1100 yards, six fathoms; so that, of its area, 320 acres would have from six to two fathoms at low water, and 130 acres under two fathoms.

With these general remarks as to the advantages, site, &c., of the proposed harbour, and its piers, I must pass to the important subject of construction, referring the Commission to the plans No. 3 and 4,—a glance at which will inform you that my pier design embraces the novel feature of my invention of the ponderous-footed pile, (in the present design a granite foot,) in respect to which I must, as an amateur engineer, entreat your liberal consideration; though, as regards the proposed piers, its principle being so simple, and its advantages and economy so apparent, I may venture to present it to your strictest investigation. Of my pier plan generally I must observe, that the great principles I have had in view in planning its construction (in the details of which, and in its calculations of cost, I have been ably assisted by Mr. Alexander Dawson, a Civil Engineer) have been—strength, durability, facility of construction, and reasonableness of cost; that its constituents are, blocks of the hardest chalk, concrete, iron, and stone, in parts so arranged as to form in construction a structure of immense strength, easy of execution, and calculated to last for ages; while its cost will be satisfactorily shown to be so comparatively small, from its peculiar design, and the present extraordinary low price at which its iron piles, and other iron work, can be contracted for, (say from 5*l.* to 6*l.* per ton,) as to recommend it, I trust, most powerfully to the consideration of the Commission and of the Government.

Referring the Commission to the general dimensions of piers, and their constituents, at foot of plan No. 3, I will now endeavour to furnish you with the fullest particulars of each specified part. And first, of the iron piles for piers. Their shape and dimensions will be found fully given in the details plan No. 4. The weight of iron is 120 lbs. to the lineal foot; giving, it is considered, an abundant strength, and ensuring durability. Inquiries have been made as to their being cast, and it is found they can, if desired, be cast in lengths of from 50 to 60 feet; but as their structure presents a simple mode of junction, (explained by the elevations A and B on No. 4 plan,) the casting in great lengths may not be considered desirable.\* Of the application of these piles it is unnecessary to offer remark: their general advantages, and superiority to piles of wood, (as in my first pier design,) are self-evident.

The ponderous feet of piles for a clay bottom, which will be found to exist on the proposed site for piers, where a chalk bottom (which prevails most) does not occur, are composed of granite, their dimensions being 5 feet high by 4 feet square, and their shape and weight designed to plant them firmly in the subsoil; this simple invention, affording to pile-work a foundation at a small cost, equal in security, it is apprehended, to a massive one of masonry of stone. The size of the feet of piles can of course be increased or diminished, as deemed advisable. The foot of pile for a chalk bottom is of iron, for the insertion of which in the chalk a small chamber, by a simple process, would be made. The interior of the piers is composed, to low-water level, of large square blocks of the hardest chalk for the outsides of the foundation, regularly bonded, the weights of which would average from one to two tons, (the chalk rock of East Cliff being of the hardest and best quality in the district,) and be furnished immediately contiguous to each proposed pier, where chalk quarries could be purchased for about 500*l.* respectively. The chalk blocks would be lowered into their berths from the pier platform of operations, down inclined conducting timbers, which would be so adjusted as to determine, with the greatest precision, without the use of the diving-bell, their exact position below, where, when placed, they would be secured from waste through any action upon them of the sea, by the stone casing in the grooves of piles, and form, so protected, an excellent and reasonable foundation. The foundation within the outside blocks of chalk, to low-water level, excepting one course of chalk blocks terminating it, is rubble chalk, in lumps averaging from a quarter to one ton, cast in

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\* An elevation of a hollow pile will be also found on the details plan.



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from the pier platform, and allowed to dispose itself and settle in the space between the outsides, the interstices being filled up with fine shingle, forming a foundation, in conjunction with the outside blocks of squared and bonded chalk, of the firmest nature, and expeditious of execution. The interior core above low-water level is of rubble chalk, grouted with concrete; the grouting in proportions of six of shingle, two of sand, and one of cement. This core is designed with a view at once to economy, by a saving of concrete, and, as being grouted, possessing a compactness and strength little inferior to the concrete which encloses it: its width at top is 10 feet, and at bottom 25 feet; which dimensions, it may perhaps be considered, may, without any diminution of the strength of the interior of the pier, be increased; whereby a saving would of course be made. The concrete sides, which enclose the core, and back the stone slabs in grooves of piles, is composed of shingle, cement, and sand, in proportions of four of shingle, one of cement, and two of sand; this description of concrete being used from its greater strength, and having no disposition to expand, as does concrete formed with lime: it would, as made, be cast down from the platform into the space between the core, as erected, and stone slabs, simultaneously placed in the grooves of piles; and there form, in conjunction with them, an interior equal to one of stone masonry: indeed, the nature of this composition is such, that if it be properly prepared and applied, (blocks of chalk being cast in on the top of each adhering layer, so timed as to key them together as they are cast,) it will ultimately form a mass equal to one immense stone, from the top of the pier to its foundation of chalk, wedging the interior core and the stone facing! And here, I trust, I shall be pardoned in calling the particular attention of the Commission to the combined effect of the constituents of the interior of the pier proposed by me, and now under description. Looking at the transverse section of the design submitted to you, and considering what has been detailed, and is there presented to your view, I trust you will be able to pronounce—as I may venture to say others, of no mean judgment, have done—that the interior construction of my piers presents A ROCK OF STRENGTH, which, protected from waste by the stone casing, is at once calculated to resist the utmost powers of the elements to assail it, and to prove of the most lasting kind. The granite key-blocks, for fixing the chairs which secure the piles, are three in number in the design, on each side of the pier. Their dimensions are 6 feet by 4, with about 10 feet in the clear between each course—when the depth of water increases to about five fathoms, an additional course of these key-blocks is proposed;—and it is only necessary to add that, in conjunction with the iron chairs, it is presumed they will form, as embedded in the concrete, a tie to the iron piles, which, for security and compactness, cannot be surpassed by any other invention. The cast-iron chair will speak for itself under its delineation given in the details plan. The stone casing in grooves of piles is of the best Arbroath stone, four inches thick; a substance of stone which, when backed with the concrete, will have all necessary strength, and when placed in the grooves of piles will form a lateral wedge and tie from the top to the bottom of them, rendering all other lateral ties quite unnecessary, and affording to the assistance of the principle of the ponderous-footed piles an immense weight *in them*, which will be calculated to ensure their final settling and stability. The fender beams are of oak, 14 inches square. The mode of securing them to the piles is fully explained in the details plan, and their position is shown in plan No. 3. The granite parapet and curb—of which the dimensions are given on the plan No. 3—require no particular comment; nor do, perhaps, the other minor matters of finish, which are of the usual kind.

3222. What do you understand to be the quality of the holding ground of Dover?—I believe that the soundings prove that the bottom is chalk and strong loam or clay.

3223. Do you understand it to be fair good holding-ground?—Part of it particularly so; that part where the valley opens looking through the valley is considered very good holding-ground, beyond that, the ground is very hard, and vessels require anchors of a particular description, I believe, to hold in a chalk bottom, but much of the ground in the bay is good holding-ground.

3224. Do you speak to that from your own knowledge or from hearsay?—Not from my own knowledge as having sounded the bottom, but from having lived many years opposite the bay and observed the effects of gales of wind on ships anchored in the bay.

3225. Are you a seaman by profession?—No; I have become acquainted with nautical matters from having lived much of my time at the river and sea-side, and having many connexions with shipping interests.

3226. Your proposal goes only to the erection of a harbour in Dover Roads?—I apprehend that my mode of erection is applicable to other sites as well as to that of Dover, where chalk or stone can be easily procured.

3227. Have you turned your attention to the erection of asylum harbours on any other part of the coast?—No; no other part than Dover where I have resided for some time, and which place, I consider, for the reasons I have assigned in my report, (to which, on this subject, I beg respectfully to refer the Commission,) more eligible than any other situation on the south-eastern coast for a harbour of refuge. (*Mr. Steward delivered in printed copies of his Report.*)

3228. Have you anything to say more than you stated before the Committee on Shipwrecks?—I do not wish to confine myself to the evidence I gave before the Shipwreck Committee, for I had not an opportunity of going into the subject so fully as I should have wished, and I should rather refer to my printed report now before this Commission. I was the first witness examined on harbours of refuge, and the committee, at that time, were not so well disposed to entertain the subject of the erection of harbours of refuge as they became afterwards. I beg to add, that from an error of print in the Shipwreck Committee Report, the entrance of my proposed harbour at Dover is stated to be 30 instead of 1000 feet.

3229. (*Lieut.-Col. Alderson.*) You produce a section of your pier plan, where is the four-inch



stone casing which you describe as being let in between the piles?—It is shown in the front, (*pointing it out*,) but cannot be shown on the transverse section; it will be seen in the details plan.

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3230. What are those two strong wales introduced for?—They are the fender beams; they are not necessary as lateral ties; the stone facing is a vertical lateral tie; it is impossible the piles can move one way or another.

3231. Of what are they composed?—They are of oak.

3232. Of what size?—14 inches square; the mode of fixing them is explained in the details plan.

3233. The whole of the filling up behind the iron piles below water is intended to be done without the use of a coffer-dam or caisson?—Yes; I apprehend by the aid of a simple moveable platform of operations, the foundation below water could be properly deposited without seeing the bottom at all. I should propose to commence the work from the shore, and to carry it gradually out by means of a platform, by building a caisson, planting it at 50 feet distance as a buttress to the platform, the horizontal side timbers of which platform would be so adjusted as to regulate with the greatest precision the planting of the piles of the section in progress, which would be the first operation. The piles of the section being planted and secured, the next operation would be lowering the blocks which form the foundation to low water level; we know the exact content of the bottom, and by using inclined conducting timbers from the platform, down which to lower the foundation blocks, apportioned to the content of the bottom, they would be placed in their proper position; the mode will be so very simple, that I think they can be laid with the greatest exactness without the use of the diving-bell; the outside blocks being placed, the others can be laid as a matter of course, and the rubble be thrown into the interior. The work, above this foundation, would be a large concreted mass, backing the stone facing simultaneously, inserted in the grooves of piles, forming a body of great strength; it will be equal in strength to one great stone; it will be of immense strength.

3234. What is the base of your piers?—The base would depend upon the depth of water; they are 32 feet in width at top, and have an inclination of 15 degrees from the perpendicular.

3235. Did you say, that from the finishing course of your chalk foundation blocks, you propose all above to be concrete?—Not exactly so; it is all concreted, being concrete and a core grouted with concrete with a view to economy.

3236. Is there any concreting below low water level?—None.

3237. You build then on the body formed by the blocks of chalk?—Yes.

3238. What will be the size of the blocks of chalk?—They would be irregular masses, as before stated.

3239. Is all your iron cast-iron?—All the iron proposed in the plan is; but, I have to mention, that since this plan was made, I have thought it might be rendered more reasonable, if instead of the iron chain ties and blocks of granite in which they are fixed, as we have no stone at Dover, and the chalk would not be sufficiently hard for this purpose, wrought-iron bar ties from side to side were substituted, which would be much more reasonable, and perhaps equal in strength, to the mode of securing the piles before described. The first plan I conceived of (plan No. 5,) had piles of wood and ties of wood which were very strong. I am disposed to recur to this mode of tying shown on this plan, (*producing it*,) only having an iron tie and iron piles; I think this tie would be as strong perhaps as the iron chair and granite block tie. If it be considered that the iron piles would decay, still it must be admitted, that the proposed work would form a nucleus for an ultimate stone casing from top to bottom, but I should say a century must pass over before this casing or any material repairs can be required to a work of this kind.

3240. You suppose the whole to be so consolidated, as at the end of a century to allow of its having an ultimate stone casing of masonry; how long will iron last in water?—I am not prepared to say how long iron will last in water, but I am aware that iron is deteriorated by sea-water.

3241. (*Mr. Walker*.) Have you ascertained that blocks of chalk as regular and as large as those you have shown upon your plan, can be obtained for such a work as this at Dover?—I think they can be procured with great facility, our cliffs are intersected with layers of flint, and taking that to show the probable split of the chalk, I should say, we could get blocks of any required size, and of a nature very little inferior to stone.

3242. In what part of the cliff should you find it?—At the East Cliff, which is the property of Lord Guildford, and also in the neighbourhood of Archcliff Fort, and the old Folkstone Road.

3243. What is the water shown here behind, in Plan No. 1?—The Pent, which has been greatly improved by a stone quay lately erected.

3244. What will be the expense incurred in carrying out your plan?—Under a million; I have stated it in my report, and accompanying estimate for erecting the two piers described, with their lighthouses, wharfs, landing places, cranes, and every appurtenance specified, at the sum of 833,570*l*. I should say it would be under that sum, assuming that the alterations I have suggested would reduce the amount. If there were any doubts as to the facility of constructing my piers, I could show the Commission the plan I have now with me of my platform of operations, by which I could demonstrate that it would be very easily and expeditiously carried out.

[*The Witness withdrew.*]



Mr. *Henry Barrett.*

Mr. *Henry Barrett*, Author of a Treatise on Bars, &c., examined.

11th June, 1844.

3245. (*Chairman.*) Where do you reside?—In the Commercial Road.

3246. What is your occupation?—My occupation is that of an arbitrator and settler of salvages, and a surveyor of ships, &c.

3247. You appear to have given much attention to the subject of bar harbours, and the construction of breakwaters?—I have for very many years.

3248. Have the goodness to state your opinion as to the cause of the formation of bars?—My opinion as to the cause of the formation of bars is that the egress or the outgoing current is the cause; that wherever the water passes out of a river to sea, either by a natural or artificial impetus, with a sufficient velocity to carry matter in suspension, and that water expends itself, becomes inert or causes a conflicting action with the water of the ocean, then the matter drops and forms a bar, and, on the contrary, where the egress water passes out so inert that it carries nothing with it there can be no bar at the entrance of a harbour.

3249. It appears that you consider all scouring by egress water, whether natural or artificial, injurious?—Certainly; I consider that all scouring water, whether natural or artificial, is injurious, inasmuch as it causes a deposit or accumulation of bar.

3250. If the ebb tide, or sluice water, can be carried so far out as to meet the deep water in the sea, will not such a current cleanse the channels through which it passes?—If the water passes to sea with a sufficient velocity to carry it into deep water, and pass its contents into the coast tide of the ocean, it would no doubt go away into deep water, and form no bar. We have an example of that particularly at Milford Haven (and other ports), where the egress tide passes out, and immediately on its passing St. Ann's Head it goes into deep water, and falls into 18 or 20 fathoms, and the alluvial or other matter is so scattered about that there is no visible deposit at the entrance of the haven.

3251. Your observation applies wholly or principally to a flat shore in front of a harbour?—Principally so.

3252. To a case where the ebbing tide does not reach the deep water?—Yes, wherever there are bars there is generally a flat shore.

3253. Why do you object, as stated in your pamphlet, to extending piers out seaward to conduct the tide into deep water?—I am not aware that I have objected to them, unless where they interrupt the tides, and so cause the water to make a deposit.

3254. You are understood to have said, that a pier of that kind is an absurdity?—No, on the contrary I think there are means in many cases of so constructing piers as to convey the water to sea without injury, or leaving any deposit at the entrance of a harbour.

3255. Suppose, where the ebb tide or sluicing power ceases, a dredging vessel were to be used, would not that prevent the bar?—I fear that such would be the quantity of deposit that no dredging vessel could keep the coast clear, or the bottom of the sea where the deposit took place; but it would be much easier to prevent a deposit than to remove a bar which had already accumulated.

3256. You admit that if the ebb tide or the sluicing power could be made to run into deep water, such tide or sluicing power might be useful?—I beg to be understood distinctly to give an opinion that water has a scouring power where it passes through a defined space, with sufficient velocity to disturb the alluvial soil in the bed of the river, or that which has been brought in by the previous tide, but so soon as it expands itself in the ocean it immediately drops that which is carried in suspension; as I have before stated, that if the ebb water goes out with sufficient velocity to carry the matter in suspension into deep water there can be no deposit; but, in that case, I am not aware that a scouring power can be of any utility.

3257. You have said all bays have a deposit which tends to decrease the depth of water, to what bays particularly do you allude?—I allude to Dover Bay, to the bay in Lowestoff South Roads, and to many bays in the Baltic and throughout the world.

3258. Does the observation apply to any bay of any description?—To all bays; I am not aware of any exception. Take Dublin Bay as another example, from the constant deposition of sand which takes place there. In the Harbour of Kingstown, which has been built on much the same principle as Ramsgate Harbour, although there is a deposit in the inside there is no barrier or bar on the outside, for the water falls out so slowly that it carries no matter into the sea, but the disembogueing water from the Liffy drops the matter it brings down and forms a bar. The whole of Dublin Bay, like other bays, has lessened its depth of water, so it is with the Downs. In passing to Ramsgate, the depth of water has decreased very much there during the last 50 years.

3259. According to your notion there is an objection against constructing any artificial harbour?—No, I do not go to that extent.

3260. If they are built up only to be silted afterwards, what is their use?—I think there are means of letting out a backwater without its passing through the ship channel.

3261. By what means?—By a tunnel or a lateral cut into the sea, taking care that there shall be no water go out at the ship entrance.

3262. If you were called upon to construct a harbour in Dover Bay, how would you guard against this deposition of mud?—I am quite opposed to the principle of constructing harbours in the sea, for I think it is totally unnecessary. I have here a plan of a harbour which is proposed to be constructed at Holyhead (*producing the same*), the principle of this I object to. I am of opinion that in place of a harbour being constructed outside, the inner harbour ought to be deepened so as to form a good and safe harbour.

3263. What is the nature of your objection to forming a harbour outside, as shown in the plan now before you?—I have two objections; the first is the enormous expense, and the next is the length of time it must necessarily take to construct such a harbour. I am of opinion



that all the advantages which such a harbour would afford, if it were constructed, might be obtained by deepening the inner harbour, with two piers constructed, as might be determined on, and where they would operate, and in a direction most advantageously.

3264. The harbour you speak of would be a tidal harbour, would it not?—No, you might carry the piers into deep water, so as to have 14 feet at the entrance at low water.

3265. In point of fact, your piers would form an outward harbour?—Yes.

3266. Then you do away your objection to an outward harbour, or you propose a harbour of a smaller description on the outside?—The piers I propose would not form an outward harbour, but merely, as in all other objects of piers, to form a channel from sea into the harbour. Then there is another objection, and that is the great deposit which would take place in the large area of the proposed sea harbour every tide, and which must necessarily be attended with considerable expense periodically to dredge.

3267. Would not the same deposit take place with yours?—Not to the same extent, for the water would fall in with less velocity; a large portion of the deposit which would fall in this area, (*pointing to the plan*), now falls there, but the deposit would not be half so much in the inner harbour.

3268. Those are your objections to the proposed harbour at Holyhead?—My opinion also is that, in spite of all that could be done, a very considerable sea would roll in, as it does on the opposite side of the channel in Kingstown Harbour, where the ships knock themselves to pieces at times. With the large opening which is proposed at Holyhead the sea would roll in when the wind came from the northward and eastward.

3269. What length is it proposed to be?—350 feet.

3270. You think 350 feet sufficient to create this disturbance inside?—Unquestionably it does so in the harbour at Kingstown and at Scarborough, and other harbours so formed.

3271. When you compare the exposure to the action of the sea on the harbour at Holyhead by the proposed plan, and that at Kingstown, what distance, with an easterly wind, is there from the entrance of Kingstown Harbour to the nearest land?—Kingstown Harbour is built on the shore, where the sea does not fall very heavy as it does at Holyhead; there is nothing to fend off but the Isle of Man.

3272. Do you know the distance from the proposed entrance at Holyhead to the nearest land at right angles?—I am aware of no land nearer than the Lancashire coast, I believe, from Holyhead along to Beaumaris or the Great Orme's Head; there would be no shelter for this harbour. I am not aware of any land on the Welsh coast that extends sufficiently to the northward to form a protection to break off the sea from this proposed entrance. The simple remedy in Dublin Bay would be a breakwater in front of the entrance, to prevent the sea rolling in.

3273. The space for entrance is 800 feet, might they narrow that to 300?—That might be done, or if one pier lapped over the other that would have the same effect.

3274. Having done with Kingstown and Holyhead, what would you propose to do at Dover to convert the present harbour into a useful harbour?—May I first beg leave to state why I object to a harbour being made on this principle, *i. e.*, according to this plan, in Dover Bay. Captain Ladd put forth a plan (which I possess) some years ago to environ the pier head with a wall, in shallow water, but I am quite sure that the tides passing along the coast would be interrupted, and cause a rapid deposit of sand in the harbour. In spite of all you could do, there would be a very large sea rolling in, and sometimes when the wind came round to the westward, it would come in at the west opening, as shown upon the plan; but my great objection applies to the enormous expense, and the length of time for construction. I know very well that there is so much sea often rolling into Dover Bay that they would be stopped in their works for weeks. I beg to say that if it was thought worth while to improve Dover Harbour, I think all the advantages which could be obtained by that long process, might be accomplished by extending the Dover piers further into the sea.

3275. That is by extending the harbour in a different way from that proposed?—Yes, extending the piers southward into 10, 12, 14, or 15 feet water, at low water, that would make it adequate for all the coasting and foreign trade, which would be an important improvement.

3276. Supposing that you extended the piers at Dover in the way you propose, how could it be a harbour of refuge for ships coming in?—There would be plenty of room, and you might make the harbour 16 feet deep at low water, all the way up to the inner bridge, by excavations.

3277. You would propose to enlarge the harbour and deepen it?—Yes.

3278. Do you propose that as a matter of economy?—I apprehend that it would be done at a much less expense than that which is proposed, building out a great harbour into the sea.

3279. How many acres is there in the present harbour?—About 25 acres perhaps.

3280. Would that be at all adequate for a harbour of refuge?—Yes, with the proposed extension, probably 40 to 50 acres, I apprehend it would be.

3281. You propose to obtain 16 feet water?—You might go to any depth you pleased; but, there is an impossibility now of an entrance to Dover Harbour at times, because the present piers do not extend beyond low water mark, and therefore the accumulation of the beach blocks up the entrance to the harbour.

3282. Many of the ships that require shelter and protection, large merchant ships, will require 20 feet, how would your harbour provide for those ships?—I quite admit it would not, but it would be extremely expensive to provide a harbour fit for them; for a ship requiring 20 feet water I think it would be altogether impracticable, and that according to the plan proposed, a ship of 20 feet would very probably strike in that harbour when there was a

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3283. You refer to the shallowness in Dover Bay as an objection, are you aware that at the distance of 175 yards there is 18 feet water?—Just in one place, but not all along the coast.

3284. Are you aware that at 200 yards from the shore there is 20 feet water?—I was not.

3285. Then you condemn the harbour without being aware of the facts?—I give a general opinion, there may be an exception in some part of the bay.

3286. Are you aware that at 225 yards there is 30 feet water?—Yes, I have no doubt that may be a fact.

3287. Should you think that with such a depth of water there is any apprehension of ships striking there?—I apprehend that with the great swell of the sea that would be the case sometimes when a ship trails in towards the shore.

3288. How can the swell find its way in through a stone wall?—It will find its way in at the ship entrances, as it does now into the present harbour at Dover.

3289. You say that all scouring water, whether natural or artificial, is injurious, and you think, generally speaking, the interior water should be passed out by some other than the ship's passage?—That is my opinion.

3290. (*Mr. Walker.*) You know perfectly well the harbour of Yarmouth; is it your opinion that the water which now passes in at the harbour mouth, and goes up through the town, and into the Breydon, should be passed out by some other than the ship channel?—I think so, and I assign my reason. I conceive the tidal water there passing out of Yarmouth Harbour is entirely the cause of Yarmouth Bar.

3291. Supposing that to be the case, what is it that makes a channel at all between the town of Yarmouth and the sea? what is there but the water passing in and out daily that effects that?—The natural river which has existed from time immemorial.

3292. Do you mean to say that it is the water of the Yare?—On the bed of the river, generally speaking, there is a deposit from the inner rivers, so that they are obliged to dredge the harbour frequently.

3293. Do you suppose that the passage would remain, and the entrance would continue open, if it were not for the water passing in and out through it?—The flood would run as it does now, and ever has done; but, I apprehend, if there was not any ebb returned out the ship channel, the bar would fall away, as it did formerly, on a new channel being cut out to the sea, and that, if the cause of bars were removed the effects would cease.

3294. Would you allow the water to enter by its present passage?—Yes.

3295. But you would send it out by another passage?—Yes.

3296. Your plan would be to let the flood tide pass in by one passage, and to let the Breydon empty itself by another passage?—Yes, I apprehend the effects of egress waters are the same throughout the world; wherever there is egress waters passing out I find there is a formation of bars or sands. We observe the sands in the ocean, whether the Goodwin or any other, if you get on them at low water they are quite loose and quick, and you sink down some inches. It might be supposed that the impinging billows and the force of the tides would scatter them, but the original cause of the formation of the sands being constantly in operation each tide, the body is kept up and remains although the form may be altered.

3297. Referring again to Dover, if a breakwater harbour were to be constructed there, with an outer wall, in 38 to 40 feet at low water spring tides, and having the depth of water before described within, do you think that would be sufficient as a harbour of refuge for any vessels?—I cannot offer any objection to it, provided there should be that depth of water, at a fair cable's length from the walls for such a vessel, but then there will be an accumulation take place within the harbour between the walls and the shore, which will probably amount to 18 inches per annum.

3298. Why do you suppose it will be to that amount?—Because we have ascertained that it is to that amount in passing along the coast wherever it is let into a basin, and the water becomes quiescent. The late Mr. Smeaton ascertained that, at Ramsgate, 60 years ago, whether the space enclosed be large or small the accumulation on the bed of the ocean will amount to that annually over the entire bed of the basin or harbour.

3299. You mean to say that in all harbours this deposit takes place?—Yes, where the bed of the sea is susceptible of being removed by the tidal waters.

3300. (*Chairman.*) Do you not think that by paying attention to the bottom of the harbour with a dredging vessel, or a harrowing machine, it might be kept clear?—The harrowing the bottom would merely set it loose, just like shaking sand in a decanter, then it would be carried to and fro, and fall wherever the impetus ceased to operate, and which would be at the proposed entrances of the harbour, and so form bars. The only thing that could be done would be to dredge it, then it comes to a question of expense, but the dredging could only be done in fine weather.

3301. Seeing the plan now before you, and the large space, even by the smallest of those plans, proposed to be enclosed, do you still retain the opinion that anything which should be done to the present harbour of Dover could form it into a port of refuge, adequate to the reception of the ships, contemplated under any one of those plans?—I think it would answer the purpose, except for the largest class of ships, and I fear if an exterior harbour were provided for them it would not remain so, from the impossibility of preventing the decrease of water.

3302. Are you aware that the smaller plan includes 450 acres?—Yes, and the larger the harbour the greater the difficulty of dredging.

3303. You would enclose only 25 acres?—Yes.



3304. For what number of vessels should you consider yourself as providing accommodation?—I should expect there never would be more than 100 sail of vessels there.

3305. The accommodation required for the trade of the country would go far beyond 100 sail. In Ramsgate Harbour alone there have been 370 sail at one time?—That has been the case, but all the vessels going down channel would not put into Dover, some would go under Dungeness, others to the Downs, and others to Ramsgate.

3306. Will not the harbour you propose be liable to fill up in time, as you suppose that the larger would be?—Then they must have the dredging machine often as it may be required, but the quantity of deposit would be comparatively small, and the dredge might work in all weathers.

3307. The dredging is in proportion to the accommodation afforded?—Yes, of course.

3308. You consider, as may be inferred from your petition to the House of Commons, that civil engineers are not persons competent to deal with the formation of harbours of refuge?—That is a most delicate question to deal with, but, with much submission, may I beg to state that it is not only my opinion, but it is the opinion of other persons, that the science of harbour making requires a very considerable degree of nautical and practical knowledge, before any person can be competent to give an opinion as to how piers and harbours should be constructed; and particularly their entrance, so as to receive the force of the impinging billows with as little effect as possible, and with but little resistance to the tides passing along the coast. These matters ought to engage the attention of the engineer who presumes to plan or construct harbours, but generally speaking these gentlemen have been at fault. We have obvious proofs that the engineers have been incorrect. If we take the case of Dover Harbour, for with all which has been done or expended there, the entrance is not deeper than it was in the reign of Queen Elizabeth, in fact, the depth is less than it was at that time, although there have been several entrances made, and attempts to improve it, at an enormous cost.

3309. What nautical engineer can you name who is, in your opinion, the person to be intrusted with such a commission?—I would not take the liberty of naming any one. In the Report of the Committee of the House of Commons on Dover Harbour in 1836, the Honourable Commissioners will find Captain Boxer's, R. N., opinion, and the opinion of pilots on this subject.

3310. Will you have the goodness to state what was your object in presenting your petition to the House of Commons?—My object was to be heard upon this subject, and to show that the principle of the scouring power was generally injurious, and never beneficial. The Honourable Commissioners are aware of the effect produced on Lowestoft Harbour by the scouring power. May I beg leave to direct the attention of the Commissioners to the proposed harbour at Foreness, the mouth of which, or its entrance, is to be at the north-west side. Vessels generally part from their anchors and cables in the Downs; with the wind from the south-west, and with a lee or flood tide, when they come up to the North Foreland, supposing the ebb tide to be down, how is it possible for a ship in a heavy gale of wind and a dark night to fetch up to the entrance and get in? therefore she would be driven into the North Sea in a perilous condition.

3311. What would there be to prevent a ship breaking adrift in the manner you have described, anchoring under the lee of this harbour in smooth water?—I am assuming that she has lost her cables and anchors; but let us suppose that a ship had entered this proposed harbour, and a gale of wind from the north round to the east, it would be impossible for a ship to get out, although these winds would be fair to proceed down channel.

3312. You say you are opposed to the construction of a harbour of refuge by running a breakwater into the sea?—Yes.

3313. And that you would, in every case, improve a tidal harbour?—Not without some exception. My attention may be directed to such a place as Ramsgate, where there is no means of doing that, or forming an entrance harbour, without cutting down the chalk cliff.

3314. At Dover you would prefer enlarging the harbour?—Yes.

3315. How would you do that to the extent of providing for the accommodation of 300 or 400 vessels?—I quite admit that, if the object is to provide for the accommodation of 300 or 400 vessels, my plan would not be sufficient, unless Dover Harbour could be extended so as to comprise an area of 50 to 60 acres.

3316. At Dungeness, how should you proceed to construct a harbour of refuge; by any inland construction or excavation?—This is what I propose (*producing a plan*).

3317. This plan was proposed some years ago, was it not?—Yes; I think in the year 1837, by myself.

3318. Here is a large quadrangular basin; how large is that?—I believe I proposed it to be sufficiently large to contain 150 sail of vessels, together with the entrances to the basin, where vessels might be moored.

3319. By what process do you propose to keep this clear from shingle?—I believe the piers would be extended into deep water, where no shingle would accumulate; for if you carry out your piers where the sea does not break, so as to disturb the bed of the sea, we do not find the shingle moves.

3320. To what extent should you have to carry your piers out to get that accommodation?—I cannot remember exactly.

3321. Do not you suppose this is an engineering work on which the civil engineers of the country may be competent to form a judgment?—I apprehend, in carrying out these works, civil engineers must be called in, but not in the planning.

3322. They would be necessary in the execution, but not in the planning?—Just so.

3323. Did you ever attend any committee about this harbour?—I did so.

3324. When was that?—I think it was in 1837, and Sir George Cockburn was in the chair.

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3325. Do you think that a strong westerly wind in this narrow passage (*pointing to the plan of Dungeness Harbour*) would not be objectionable?—That was one of our reasons for having another passage; supposing the sea to run very heavy from the west, a vessel could go round to the other side.

3326. How could she possibly do that with a gale of wind?—She might anchor under the East Ness Point; but I do not admit that there would be so much sea as to prevent any vessel running in at the west entrance; but if there was she would be under the weather shore by going round.

3327. Then it would not be a harbour of refuge, as she could not always make it available?—Not on the weather side; she might enter at all times on the lee side.

3328. With your object of constructing a harbour of refuge, how should you proceed off Eastbourne? there is no tidal harbour there?—I beg to say I should never propose such a harbour. Ships lying under Beachy Head, and the wind suddenly changing round to the eastward, it would be impossible to protect them, or get out and round Beachy Head. I think if there were a good harbour at Dover, and another at Dungeness, and another in the Downs, that is all which is required between the Downs and Portsmouth.

3329. What is your estimate for a harbour at Dungeness?—I think 170,000*l*. We have an opportunity of calculating, with some degree of accuracy, what it will cost. We know what the excavation will cost, and what the piers will about cost each square foot; and, therefore, we can make the calculation with some precision.

3330. How can you provide against the entrances filling up with a large quantity of shingle travelling round?—I know there is an annual increase of the point. I am of opinion that if those piers were carried into deep water the shingle would accumulate on the beach, near the piers, probably more than it does at present, and that it would fall on and form on the flood side a right angle of shingle; but it would only extend to a small distance from the shore along the piers.

3331. Your piers would act as groins on each side?—Precisely so; if they were carried out in the way proposed I think there would be no shingle brought to the pier-head, where the current would be exceedingly strong; but suppose it did reach to the pier-head, it would be carried away, for there would be no in-draught to take it in between the piers.

3332. Have you any proposal to offer to the Commissioners as to what, in your opinion, would be the best position in which to construct an asylum harbour in the channel, on the coast between the mouth of the Thames and Portsmouth, capable of receiving men-of-war of the first class and the largest description of merchant ships of an outward and homeward fleet?—I have no such suggestion to offer.

3333. You were understood to say that you had an objection generally to constructing a harbour in the sea?—I have, for the reasons I have assigned.

3334. Have you any remedy to propose to prevent such deposits, which you believe to be taking place in all bays, and in the mouths of harbours generally?—If you separate the questions I will answer them. I know of no means to prevent the deposit in bays; but as to harbours, I contend that bars are the effect of some cause; and if the cause is not in operation, no accumulation can take place.

3335. Have you any remedy to propose?—My remedy is to remove the cause, as I have before said.

3336. Be good enough to state what in your opinion is the cause?—I believe it is, as I have already stated, the result of the egress waters and the confluent action of the sea, just as we see at London Bridge, where a great deposit takes place during the ebbing tides.

3337. As you have only 12 feet at low water in the harbour you propose at Dungeness, what use is to be made of this harbour?—We could produce more water through it, if we carried our piers further out; but it has been considered that that would be sufficient.

3338. If you had a greater depth of water at the entrance, should you propose to have a greater depth all the way up?—Yes, certainly, the same in the basin as at the pier ends.

3339. What is your width between your piers?—I think, as far as my recollection goes, we intended to have it about 100 feet.

3340. Do you think a ship, running in in a gale of wind, with a heavy sea, could steer in conveniently with 100 feet passage?—I should have no doubt of it.

3341. You say you are acquainted with the locality of Dover and the Channel in general; do you consider that, by running out a pier in deep water from Cheeseman's Head and excavating the inner harbour, sufficient space might be obtained to give shelter afloat to the packets on that station, and to a squadron of war steamers?—I think all those objects might be obtained by my proposal.

3342. Do you think that, if such a pier were run from Cheeseman's Head into deep water, the shingle would be thrown so far out, and so deposit as to give no further trouble there?—Yes; but I should not extend my pier from Cheeseman's Head, but from the present pier, or a few feet westward from it.

3343. You think that would stop the shingle?—I am quite sure that, if the piers were carried into deep water, the shingle would never find its way round them, or make a lodgement there. I think a great error has prevailed for some years on the subject of the travelling of the shingle among the Dover people; they have supposed that the shingle all came from the westward. I believe this to be a fallacy. I think, on the contrary, it alternately accumulates up, and is again drawn off the beach. With a heavy south-west wind the floods come up and accumulate the shingle along the coast; and then, when the wind changes, the ebb tide pulls it back again into the sea, from whence it had been dislodged; so that it does not travel from the westward in the way it has been stated.

3344. If you have nine months westerly wind and only three months easterly wind, does not



that come pretty much to the same?—Although there is a prevalence of westerly winds, the shingle does not increase on the beach, except in extraordinary tides. That there has been, during past years, an increase of beach on the Kentish coast is obvious, for Dover and Deal are both situate on what may be called a modern accumulation; and the coast of Great Yarmouth and other places have undergone a similar change. If 25,000*l.* were immediately applied towards the extension of Dover pier, the beneficial effects would be seen ere the present year passed away. But the Dover people seem to think that all the shingle comes from Dungeness, or the westward.

[*The Witness withdrew.*]

Captain Sir *Samuel Brown*, R.N., K.H., examined.

3345. (*Chairman.*) You are the constructor of the Brighton Pier, of suspension bridges, and the originator of chain cables?—Yes.

3346. Have the goodness to state what is your proposition?—I have not come prepared with any specific proposition; I attend here in consequence of a note stating that the Commissioners wished to see me to-day at two o'clock; but I shall be happy to avail myself of this occasion to state the objects I have in view. First in order, because the subject has engaged my earliest attention, I would recommend that the construction of stone towers on insulated rocks for the purposes of lighthouses should be discontinued, and that wherever sea lights are required on similar situations, that bronze columnal lighthouses of the same altitude should be erected, adapted for the reception of lights of the first quality, and affording ample accommodation for the light-keeper's stores and provisions; which could in most instances be supplied for one-eighth part of the expense, and in one-fifth part of the time; for example, the Pollard Rock, one of the seven stones, the Cunnybeg Rock, near the Saltees, and various others. The Skerry Lighthouse, the last, now nearly completed, in point of magnitude and expense throw all other works of that description into the shade; it contains nearly times more solid masonry than the Eddystone tower, and it is admitted by Mr. Allan Stephenson, under whose directions it was executed, to have cost 95,000*l.*; but I believe that this estimate only embraces the tower itself, and that they have not charged that work with the refuge harbour on the island of Taree, without which it could not have been attempted; and I have not the smallest doubt that, by the time it is entirely completed, that it will have cost 110,000*l.*; whereas the bronze columnal light, in every point of view superior, could have been erected for 10,000*l.* to 12,000*l.*, and completed in four or five months. In point of fact, I made a specific offer to construct it for that sum, and to guarantee its stability for three years. I may just observe, that the expedition with which the bronze column can be completed is even of more importance than the immense saving of expense; for it has been ascertained that several most deplorable and fatal shipwrecks occurred while the works were in progress, which would have been prevented by the more speedy exhibition of the light.

3347. Have you ever made any statement of this to the Trinity House?—No, except through the medium of my pamphlet for the proposition to which I have alluded to; the Northern Light Commissioners in Edinburgh, I believe, are entirely independent of the Trinity Board in London.

3348. Have you ever given much thought to the construction of breakwaters?—Yes: the subject of fixed and floating breakwaters has for a considerable time engaged my attention, and I have prepared models of both those plans; the fixed breakwater was too large to bring it here to exhibit on so short a notice, but I have brought a sketch of it here, which will give a very imperfect idea of it. I have, however, brought the model of the floating breakwater (*producing it*). In point of principle there is no material difference between my plan and Captain Tayler's. In the construction I employ bronze, which is imperishable, instead of timber, which, besides the decay of the material, is liable to be destroyed by worms or marine insects.

3349. What is the inside?—Turf packed between the bars would answer the purpose; but it is not very material whether it is filled with turf or cork.

3350. Does not the turf wash away?—No; the openings of the frame are so small it would not escape.

3351. How is it floated?—It is floated by the cylinder, which displaces the necessary quantity of water to give it the desired buoyancy.

3352. What are the bars made of?—Of bronze; they are supposed to be six inches wide and a quarter of an inch thick.

3353. Do you find bronze better than iron?—Yes; but not in a mechanical point of view. If we could depend upon this new chemical proposition of galvanised iron it would answer quite as well, and of course be a great deal cheaper; but we have not had sufficient experience of its durability. In the construction of a fixed breakwater, it might be desirable to use the galvanised bars in one section, in order to prove its efficacy.

3354. By bronze do you mean a mixture of copper and tin?—Yes.

3355. What is the difference of price between bronze and iron?—Bronze for a lighthouse or breakwater would cost about 100*l.* per ton; the galvanised iron, I should think, would be about 40*l.*

3356. What is your plan for a fixed breakwater?—I can give a very imperfect idea of that by perspective drawing. This is supposed to be a perspective view of it (*producing it*.) The front elevation opposed to the sea is 20 feet in height 2 feet above low-water mark; the back or inner elevation is 54 feet, being 10 feet above high-water mark. The lower part of the



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fixed breakwater may be either open work, to allow the passage of the shingle or sand, or, if it is desirable, it can be made close to intercept it, so that the accumulation may form the base of the breakwater.

3357. Under what circumstances can it be desirable that the shingle should pass through?—The obstruction to the natural diffusion of the shingle, while it affords protection against the force of the sea in some places, proves most injurious, and indeed destructive, in others; for instance, the Black Rock Groyne at Brighton, which I believe is about 150 or nearly 200 feet in extent, has caused an accumulation of beach to a great height, and laid the adjoining ground bare to the chalk, which exposed the cliff to the violent surge of the waves, which caused an immense fall of the adjoining cliff.

3358. What proportion of slope do you give to your breakwater?—Thirty to thirty-five degrees.

3359. Is there any wood in the outside frame of your breakwater?—No; the whole interior, consisting of transverse and longitudinal bars, diagonal and upright shores or pillars, and other framing, is bronze.

3360. Have you ever thought about a harbour in the neighbourhood of Beachy Head?—No; not, at least, so far as to enable me to form an opinion of its eligibility.

3361. On which side do you think it is most desirable?—If it were possible to run it out from south-south-west to south-south-east, from Beachy Head; there would be good shelter on either side, according to the state of the wind. On the east side of Beachy Head, with the wind at south-west, it is quite smooth; and when the wind is easterly, occasionally may be seen a large fleet of vessels riding to the westward of the Head.

3362. Do you mean in Seaford Bay?—I should have said Seaford Head.

3363. When you have been contemplating building a breakwater, have you thought of any particular place?—There is hardly any part of the coast where I believe a breakwater could not be formed; but the situations where it would be most useful are, I should say, first, at the Brake Sand. I have heard it said that the Brake Sand has shifted, but I believe there is no change in the position of the main body; and what is considered shifting, I take to be an accumulation of sand thrown over the bank by prevailing north-east winds.

3364. Does not the very fact of the accumulation of sand and mud in the anchorage show that it is not a fit place for a harbour?—If that fact is clearly ascertained, of course only small vessels could ride there; but, if I recollect right, there is still from five to six fathoms water inside of the Brake.

3365. The expression in the public notice which the Trinity House have given to the world is, that the sand has shifted bodily in?—My opinion is merely speculative.

3366. Do not you believe that sands do shift in that way?—I believe the Hasborough Sand has shifted, but we do not hear of the Goodwin Sands moving. I would not propose a breakwater in the part of the sand which is ascertained to be shifted.

3367. What is the duration of iron under salt water?—I think that iron which is accessible every tide may be preserved by the common preservative of cleansing and painting.

3368. Do you mean malleable iron?—Either.

3369. With respect to cast iron; do you think it possible by the same means to prevent its being converted into plumbago?—The chemists differ about that.

3370. Is there any way of preventing it?—No; there is no way of preventing it when it is constantly submerged in sea-water, unless the galvanic process is effectual.

3371. Whose proposition is the galvanizing?—It is a Company; I do not recollect the firm.

3372. Have you heard what progress they have made in galvanizing iron?—Some of the reports, I understand, have been very good indeed; but I may mention what Captain Wellbank, one of the elder brethren, a few days ago stated—that the buoys which are hooped with iron formerly became so corroded, and exuded a sort of yellow ochre, which spread and destroyed the distinguishing colour of the buoys, which was prevented by the galvanic process. Recurring to the subject of breakwaters, it may be an objection that the sand shifts, but there are many places which are free from this insuperable objection where breakwaters on my plan could be constructed with infinite advantage; and there is no place in the kingdom where it would be so easily effected, or of such great utility to the coasting trade, as the shoal called the Smithwick, in Bridlington Bay, which is three miles and a half in extent, and the depth of water on the ridge or centre of the shoal, which is rocky or hard ground, not more than 12 or 14 feet; for more than two miles and a half within which there is clear anchorage two or three miles in extent, which would contain at least 200 sail, the depth varying (*see Chart*) from five to seven fathoms.

3373. What depth of water did you say there was on the roadstead?—From five to seven or eight fathoms.

3374. Is it good holding ground?—Yes, excellent holding ground; and the shoal may be considered a breakwater half made, only requiring to be completed by the transportable breakwater.

3375. You are speaking of building upon this sand; by what method would you do it?—The breakwater; I have been very imperfectly understood without inspecting the model. The form is nearly similar, but of greater dimensions, to rest on the ground, as the floating breakwater, and then the inner ledge of breakwater would be about 12 feet above high water spring tides.

3376. Would you propose that of bronze?—Yes.

3377. With a platform to work on it would form an inclined plane of 30 to 35 degrees, and this inclined plane would be filled in at given distances, after it was sunk, with oblong square blocks of granite, forming a series of ledges rising like steps one above the other.



3378. You have stated that Smithwick Sand forms a protection to the ships lying in the roadstead within it?—No; it can form no protection with the wind from the south-east in its present state, because, at high water, the sea rolls in over it without being much subdued.

3379. When the wind is in the direction to cross the Smithwick Sand it forms a protection?—Only at low water; but it is a very good anchorage now with the wind from west-north-west to east-north-east, but with the wind from east to southward of east, it is no protection.

3380. Does the Smithwick Sand form a protection at all?—Yes, it forms a protection at low water.

3381. Does not it form a protection until half-flood?—It does.

3382. What depth is there at low water?—Twelve feet for a very considerable extent.

3383. What is the lift of the tide?—I presume from 18 to 20 feet.

3384. Would it form a protection until there be a depth of 22 feet over it?—No; it forms very little protection; the sea would break over it at 22 feet, and of course there would be comparatively smooth water within the breakers, but at high water, when there was five fathoms over it, there would be no shelter.

3385. If that be the case that the protection is formed by a sand which does not reach nearer than 12 feet of the surface of the water at low water, and which is 10 feet more at half-flood, do you think that a floating breakwater which only intercepts about 6 feet in depth of the surface of the sea, and allows all below to be perfectly open, would ever form that kind of protection which is desirable to a fleet of ships within it?—I should say that a floating breakwater is only applicable in deep water. It could not be laid down or moored on a shoal exposed to the effect of a heavy sea; it would strike the ground under such circumstances, as it would draw 10 or 12 feet, and be dashed to pieces: 6 fathoms on any exposed coast or bay is the least depth that could suit a floating breakwater.

3386. The breakwater formed by the Smithwick Sand, which has 10 feet over it at low water, and 20 feet over it at half-flood, forms a breakwater by intercepting from the surface of the ground up to within 20 feet of low water?—Yes.

3387. If you are going to moor a floating breakwater in deep water, do you not leave every part open to the sea except the surface, which is intercepted by your 6, or 8, or 10 feet of breakwater?—Yes; speaking in some degree from analogy, a boat will be under the lee of a frigate, sheltered from the heaviest sea, which may be considered as one length or section of a floating breakwater, which only requires to be extended to afford similar protection.

3388. Is not that by cutting off the wave, but leaving the motion of the sea under the ship's keel just as it was?—No doubt there would be an undulation, a ground swell and lift, or onward motion. The crest of the wave being broken can never acquire fresh volume.

3389. You state that the Brake is a breakwater at present?—Yes; during certain periods of the tide it must be.

3390. How many feet is there over it at low water?—On reference to the chart there appears to be only 10 feet; in some parts the greatest depth required for establishing the breakwater would be three fathoms. There is upwards of two miles of this uniform depth in the best site for a breakwater.

3391. But it forms a breakwater already?—Yes, and so do the Margate and many other sands, as long as the sea breaks over them. It was the observation of these natural causes which first gave rise to the idea of converting a sand-shoal into a permanent breakwater. There is not a sand-bank in the United Kingdom, excepting such as are known to be moveable, which may not, at a comparatively small expense, be rendered a most effectual breakwater. I have not the least doubt, though a floating breakwater would not afford such complete shelter as a fixed one, that many situations which cannot now be considered as roadsteads, might, by this means, be resorted to with perfect safety.

3392. Cutting off the wave but leaving the rise and fall of the water as it is?—Yes; the best received theory is that the one half of the wave is above the ordinary level of the sea, and the other half below it: for instance, suppose we assume that waves are running 20 feet high, then what we term the hollow or trough of the sea is 10 feet below the smooth water level consequently the bottom or lower part of the structure would be, when lifted by the wave, on the same level as the trough of the sea, and the upper part would be on the same level or a few feet above the crest of the wave; and as we must presume that it is securely held in its place by the moorings, the obstruction must break down waves in succession.

3393. Do you wish the Commissioners to understand from that that a floating breakwater of ten feet would completely cut off all the movement of the sea below that level?—These observations are principally applied to the narrow seas. I do not say that in the open sea it would, but that may be met by increasing the dimensions of the breakwater.

3394. You will see that if that be correct, it is inconsistent with your remark on the Brake Sand forming a breakwater or protection, as the substance, either of the one or the other of those sands is not less than 10 or 12 feet below low water?—I have stated that it was impossible to lay down a floating breakwater in such situations; if it struck, it would, like a ship, be dashed to pieces; and what would prove fatal to the floating breakwater is the fundamental principle on which the system of fixed breakwaters is sustained.

3395. (Mr. Walker.) I have put these questions to Sir Samuel Brown, considering that the navy is greatly indebted to him for his important invention of the chain cable, and that civil engineering is indebted to him for his invention of suspension bridges, which he has stated to me was first suggested by paying attention to a spider's web, which demonstrates the principle of the catenarian curve as evidently as by the extension of the strongest chains.

[The Witness withdrew.]

Adjourned till to-morrow at 12 o'clock.

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Admiral Sir T. BYAM MARTIN, in the Chair.

Wednesday, June 12th, 1844.

Mr. William Henry Smith, examined.

Mr. W. H. Smith.

12th June, 1844.

3395\*. (*Chairman.*) Where do you reside?—33, Fitzroy-street.

3396. What is your profession?—Civil engineer.

3397. How long have you been engaged in business as a civil engineer?—About 14 years. I do not mean to say all that time on my own account, but since I commenced.

3398. Where have you been chiefly employed during that time?—I was first employed as one of the engineers in the construction of the St. Helen and Runcorn Gap Railway and Docks.

3399. On what occasions have you been professionally employed?—I have been professionally employed on the Leeds and Manchester Railway, and on the Great Western Railway. I was one of the engineers of the latter upon the first length out of London, where I continued up to the opening of that portion of the line; and still more recently I was engineer to the proposed Portishead and Clifton stone breakwater pier and road.

3400. You profess to have given your attention to floating breakwaters?—I do.

3401. What is the description of breakwater that you propose?—From an inspection of the drawings and model, it will be seen that from the peculiar direction in which this breakwater floats, the force of the sea, instead of driving it below the surface in severe storms, would rather tend to raise it upwards, in proportion to the momentum of the wave, counteracted by the opposite tendency of the moorings. The comparative freedom from strain or injury is obtained by the peculiar manner in which this breakwater is moored. Instead of being unyieldingly anchored to the bottom of the sea, and thereby exposed to the full violence of the waves, it has a play of from 20 to 30 feet, to which extent it may for a time be driven by the sea in bad weather, but from which it gradually returns to its original position. This effect is produced by attaching to the middle of the mooring-chains a counteracting weight, which, in calm weather, or whilst in the valley of a wave, will rest at the bottom of the sea, but which, when the violence of the waves drives the breakwater towards the shore, rises with the mooring chains as they are drawn towards a straight line. By the rising of this weight the resistance offered by the breakwater increases in a tenfold proportion to the impetus of the waves, and, after overpowering their force, restores the breakwater to its original position. It is thus provided, as it were, with a spring-like action, which enables it to elude the direct shocks and momentum of the sea, and to return almost immediately to its former station. Although, as an individual, I have expressed the firmest confidence in my plans, having made calculations and practical experiments, all of which correspond, I should, nevertheless, were I to carry them out myself, test them in the severest manner. But supposing the possibility of the Government ordering their trial, the more prudent course recommended by Mr. Walker would probably be acted upon, viz., to apply them within and along the extent of such natural ridges as the Smithwick Sands, in Burlington Bay where he is of opinion they would afford protection at all times. Redcar is another situation, already partially formed by nature wherein an adaptation of this principle would be the means of making a harbour twenty times larger than Scarborough, proving an incalculable benefit to the eastern coast trade. But I most respectfully submit that, from the nearly average traffic around our coasts, there is an equal necessity at all points for harbours of refuge. I have evidence of a fleet of 50 ships being caught by a gale of wind at only 50 miles from one of these harbours, Sunderland (*Report of Committee of House of Commons, 3rd May, 1836*), and, being unable to beat in, nearly all were wrecked and lost. Now, from the enormous cost of stone breakwaters, a very limited number only can be formed, leaving unprotected hundreds of miles of coast; and, as the Duke of Wellington states, an enemy's steam-vessel would watch the ships up Channel, and seize them at the most unguarded points; whereas the cost of constructing and keeping in repair 20 floating breakwaters would not amount to so much as one of stone. They would, therefore, become very desirable adjuncts to stone, as forming intermediate stations solely for the purposes of refuge. They are certainly not in themselves calculated for batteries, unless the American floating shot-proof batteries, or Mitchell's improved screw-pile batteries, which have been so favourably received by the Ordnance, were attached to them. Indeed stone forts might, where required, be applied with equal facility; but this I should conceive quite unnecessary, as an enemy's fleet would find them no breastwork from which to fire upon the shipping or town within; on the contrary, fearing the broken and splintered timbers, they would give them a wide berth. I have brought with me models to illustrate it by a spring, showing the relative degrees in which the weights decrease; and I was surprised, when I tried the springs, to find their enormous extent of yielding quality. As the shock of the sea strikes this breakwater, it has a yielding action of about 10 or 20 feet, or from that to 30 feet to leeward. The principle of mooring is strictly analogous to that of a kite in the air—whichever way the tide swings, the blow upon this section will always be regular. I have found, in making a trial of my model on the coast, even without any ballasting, which I propose, that immediately a wave struck the section, it crested upwards. The back frame is for no other purpose than to give a little additional strength. I conceive that the plan, with interstices, or with open frame, would in either place be sufficient



without any back; and in one instance I have simply braced my frame by iron rods from corner to corner. Mr. W. H. Smith.

3402. What is the scale of your model?—It is intended to be 60 feet long and 30 feet deep. 12th June, 1844.

3403. What are the cables made of?—The cables are made of iron rods about 10 feet long, running through square timbers, and, as a matter of course, attached to each end. These timbers will have the double strength, the longitudinal strength of the timber, and that of the rods combined, which will be more than treble as much as the ordinary cable that is used—from the weights upwards. In this portion I propose hollow tubular moorings, hermetically sealed. These are attached to the bridle chains, which are chains to the upper surface. The bridle chains are rods, and moored at the required end.

3404. Have you ever been at sea?—Not as a mariner, but I have been at sea. I have had a great deal of experience in nautical matters.

3405. Where have you been?—I have been a week at sea several times. I spent a great deal of my time on the coast of the Atlantic.

3406. Have you ever been at sea in a gale of wind?—I have been at sea in a storm.

3407. Your proposition goes to prevent the breaking of the sea within the harbour, but not the swell within it?—I have shown that I do not consider that there is a swell within it, I consider that it is impossible to have a swell where the particles of matter are all in opposition to each other.

3408. Do you propose that your breakwater is to prevent any swell within the harbour?—The upper surface swell; but I never contemplated that it would create a perfectly smooth surface, but what is ordinarily termed by sailors smooth water.

3409. What are the tubes for?—To give buoyancy, and thereby there is no drag whatever from underneath upon the section.

3410. Are you acting for yourself, or in connexion with any other person?—In no way in connexion with any person.

3411. You were understood to say, that you and Captain Tayler were acting together?—We are co-patentees in what is understood as Captain Tayler's patent in the original plan.

3412. In what does your plan differ from his?—It is considered very materially to differ from his. The opinions of nautical men as to all other floating breakwaters, and at the time they were shown to the Committee of the House of Commons, the opinion of the Committee was, that they would break from their moorings. I had been studying the subject of moorings for three years; and it occurred to me, that if I could get a yielding principle it would be much better. Of course the great object that was required was the giving to it a steady pressure. A cable depending simply on its catenary formation would have a tendency to pull the section down in proportion as it was tightened. I have heard nautical men state, that ships in a gale of wind, riding at anchor in a very heavy pressure, upon some occasions have been known to go down by the bows head-foremost, under the enormous pull upon the bows; there is always a very heavy pressure.

3413. You said that you are co-patentee with Captain Tayler: are you aware of the resolution of the Select Committee of the House of Commons on Shipwrecks, after they had heard all that Captain Tayler had to say?—I believe I am.

3414. It says this:—"To the various plans and models of floating breakwaters the Committee have devoted their best attention; and considering the expense of constructing and maintaining them in repair compared with the durability of solid breakwaters (which should be calculated to endure for ages), your Committee are of opinion, that whatever may be decided on as to the formation of harbours of refuge, such national works should possess the most perfect solidity, to resist the force of any sea, afford shelter to the trade, and—a great and essential advantage—of having powerful batteries erected on them." You do not profess to have batteries erected on your breakwater?—I will, with permission, go into that subject in a short time. A battery may be formed at each end of this breakwater, as well as at each end of a stone breakwater; either a stone battery or a Mitchell's battery.

3415. But it must be independent of the breakwater?—Quite independent of the breakwater.

3416. Supposing from any accident, with all your precaution, the chain should part, or the mooring should part, the whole must be swept away to the destruction of all the vessels within it?—In the event of the cable breaking, the immediate effect of this would be to swing end on.

3417. Then all vessels within reach of it would be struck by it?—There would be no vessel lying so close to it.

3418. But at any rate, if such an accident did happen, even if the breakwater itself were not destroyed, it would let the sea in upon the vessels after having invited them in for shelter?—No, I cannot admit that, the front would only be 60 feet, and you would have five times 60 feet, opening to an ordinary breakwater.

3419. Are you aware of the rapid destruction of wood by the worm?—Yes, I am; I have paid a very great deal of attention to the subject, as it has been one of the great points of dilapidation of wooden harbours, and has been one of the great objections that has been urged against them.

3420. What do you calculate would be the duration of your wooden frame?—I take my data from a well-built merchant-vessel lasting fifty years; I calculate that this will last fifty years, but when prepared with a substance which is generally used by the Admiralty,



Mr. W. H. Smith.

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the marine insoluble glue, I do believe, as a professional man, it would last a great deal longer.

3421. Have you any proof of this insoluble glue preserving wood from the action of salt water?—I have.

3422. Where has it been tried?—It has been tried at Portsmouth, under the command of the Port Admiral, and since confirmed before it was applied to the Victoria and Albert steam-ship; I state this upon the authority of the parties who are the patentees at Limehouse. I saw a block of wood that was sent up to me to examine as a specimen.

3423. Are you aware that the piles at Brighton do not last ten years?—Yes, I am.

3424. What is the date of the Report from Mr. Walker?—The 27th of June, 1842.

3425. You cited that Report as evidence in some degree favourable to a floating breakwater?—As far as being a partial means of breaking up the operation of the sea.

3426. Are you aware that in that letter Mr. Walker expresses an opinion very unfavourable to a floating breakwater in such situations as Plymouth and Dover, and that he thought inventors were risking the character of their schemes by desiring to press them at once into such a service?—Yes, and it will be seen from what I have stated, that I approve entirely of what Mr. Walker has recommended; I remarked that the more prudent course would be, to try them behind such sands as the Smithwick, in the event of the Government adopting them. But with respect to my breakwater, which was not in existence with its improvements when Mr. Walker gave that Report, I should not hesitate to say that it might with success be placed upon any part of the coast, because the shock of the wave which would otherwise come upon it is transferred into a regular and steady pressure, therefore it becomes no more than the operation of a current.

3427. Captain Brown, in a letter to the Commissioners, has stated that 14 inch piles in six years were reduced to 10 inches; are you aware of that fact?—I have had a great deal of conversation with him; I believe I have noticed them very closely myself, I have been under the Pier at Brighton in all weathers, I have seen the shock of the sea upon it; the timber receives no chemical preparation, and I am firmly of opinion that after a slight decay, the mechanical action alone will cause serious dilapidations to all fixed surfaces that are unyielding, upon the same principle that some trees will yield before the current of a storm; whereas the more fixed, though stronger, such as the oak, would be torn up by the operation of the element.

3428. What are the defensive powers of this floating breakwater against hostile attack?—I conceive none whatever; I think they might be sunk by weights, in case of an enemy's fleet coming, in a couple of hours; but no enemy's fleet would run for shelter behind an unopen framework.

3429. Then you would not recommend floating breakwaters for constructing harbours for offensive or defensive operations, or as a station for armed vessels of war in the event of hostilities?—For the protection of shipping I should propose the necessary fortification; unlike a stone breakwater, they do not present any breastwork, and therefore it would not be necessary to have those batteries; I simply propose this in such cases, as it might be applied behind the Smithwick Sands, or the Salt Scar in Redcar; and in such cases it would form a very desirable adjunct to stone breakwaters, as forming intermediate stations or harbours of refuge.

3430. What defensive power would you give them?—The defensive power of the batteries; I conceive they are much more applicable than stone breakwaters for defence, because an enemy's fleet could not seek shelter behind them as they would behind a stone breakwater.

3431. Would you have a floating battery?—No, the batteries at the ends would be upon the ordinary well-understood principles, either stone batteries or the batteries to which I believe the Duke of Wellington alludes when he speaks of Mitchell's Pile Batteries, which have been before the Board of Ordnance.

3432. Have you any calculation of the durability of this fabric with the sea passing through it; being moored, the water gets wire-drawn through it. The water must pass through the fabric with great velocity, acting, as we know water does through an aperture, filing the timber away. Do you apprehend that the durability of this would be considerable under such circumstances?—I do.

3433. What do you conceive to be the durability of a breakwater of this description?—I should say, at least 50 years.

3434. You have stated that the action of the water upon the piles at Brighton has had a considerable effect in wearing them; would not the same action of the water take place upon this framework?—Not exactly, because I do not fully agree with the expression "filing," I conceive the rolling action of the globular particles of the water upon the surface cannot possibly be a filing, because we have the ships' sides exposed to the same action. I have stated that if I get this only to be as durable as a ship, it will answer the purpose; but I do not conceive the two cases are similar, for the fixed piles at Brighton receive an immediate shock because they are unyielding, and there is a breaking off of the particles where they rot.

3435. Have you made any calculation of the expense?—I am prepared to give the prices of a section.

3436. What is the expense of one section?—One section of 60 feet would cost 310*l.*, with everything complete; that would be when a number are constructed together. I would not attempt to put one section down alone for 1000*l.*

3437. If you were called upon to put one section down, what would you charge?—I should think 1000*l.* at least, 1,500*l.* perhaps, for this reason, I should require steamers, and the same



steamers that I could employ to draw out and lay down the whole number would be required to lay down one. Mr. W. H. Smith.

3438. What do you conceive would be the durability of the moorings ; how many years would they last ?—I should say, seven years. 12th June, 1844

3439. They would require renewal every seven years ?—Yes, the whole of the moorings would not require renewal, simply the joints ; I do not use a cable mooring.

3440. It would require reparation ?—Yes.

3441. Do you apprehend that a very large ship coming against this breakwater would do it any injury ?—No, I do not ; but that is a nautical question. Sir S. Bentham was of opinion that “ ships would cross in emergency without much injury ;” he alluded to fixed moorings ; how much more so with this yielding mooring.

3442. You have said that in case of its being required, this floating breakwater might be sunk in the course of two hours ; what means would you adopt for sinking it in so short a time ?—I should propose to weight the moorings in such a manner that the section, being so near the centre of gravity of the water, it would drive it under ; but I am of opinion that it would be needless.

If this great controversial question of stone *versus* floating breakwaters, were once decided, it would open an unbounded field for the investment of capital, not only in those harbours already established, but in numberless other well adapted localities which would eventually spring into existence as flourishing maritime towns, and thus render vast tracts of land now barren and unprofitable, a public benefit to the community at large, and a means of increased revenue to the Government.

[The Witness withdrew.]

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12th June, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Mr. Peter Jeffries, further examined.

3443. (*Chairman.*) You have been before the Commission before ?—I have.

3444. And you have desired to come again. For what purpose do you wish to appear ?—Respecting a harbour of refuge ; I was here before respecting the entrance to the present Dover Harbour and not as relating to a harbour of refuge.

3445. Will you state what your plan is for a harbour of refuge ?—If the Commissioners will allow me. I will refer to the plan which was laid before the Harbour Commission of Sir James Gordon in 1840, which plan I have got here [*producing the same.*]

3446. Are you going to speak of Dover ?—Of Dover entirely. In the first place, the harbour of Dover as represented here is very inaccurate ; it in no way resembles it.

3447. You allude only to the inner harbour as represented by the lithographer ?—Yes, I allude to this [*referring to the plan in the Report of the Commissioners of Harbours, in 1840.*] I am of opinion, that the shingle, which will be brought up from the westward, would lodge against that wall and would travel after the wall to the proposed mouth, and I am fortified in that opinion by this Report of the Commissioners as to Dungeness ; at page 7, it will there be found that the shingle at Dungeness has increased seaward, 118 yards in 47 years, which is seven feet and a half every year. The Report says, “ The shore at the southern extremity is extremely steep and descends at once into deep water, but the whole promontory consists of a vast accumulation of shingle constantly increasing and extending seaward.” It appears then that the shingle has travelled along there, where I have lain myself, under Dungeness many days when I have not been able to go down Channel, that is, the promontory of the whole bank of shingle has increased from the south-west side and also from the south-east side. So here in Dover Bay the shingle would keep increasing in the same way, but the wind could not have any power over it from the eastward to drive it away, and consequently it would lie quiescent behind that wall and go on increasing to the harbour’s mouth, and I think this passage, as to Dungeness, is conclusive, that it would be so here. Now instead of having a harbour formed as this is, my proposition would be at Dover Harbour, that Cheeseman’s Head should be shortened, that a channel should be excavated through the chalk rock on the east of the present harbour into deep water. I therefore would suggest, that the harbour should be formed of floating breakwaters on this plan, [*producing a plan,*] this is formed of wooden cylinders. I propose these to be 70 feet in length and 15 feet in diameter.

3448. That is exclusive of the ends which are 10 feet each, making the whole length 95 feet ?—Yes ; these should be ranged as is represented upon this plan in two rows, the distance between each length in each row being about 100 feet.

3449. And each length in the inner row being opposite to the opening in the outer row ?—Yes ; the one to cover the other.

3450. How many would you require altogether of those separate breakwaters ?—Supposing this chart to be correct, I put it from the Castle Jetty to come to the pier-head. I have put here about 36 cylinders.

3451. All of wood ?—Yes.

3452. Are you aware of the mischief done by worm to wood upon the coast ?—I do not apprehend that there is much mischief done to wood by the worms at Dover. Piles have been driven there repeatedly, and I could never see that there was much injury done to the piles there, but the wood could be so prepared by Mr. Payne’s process that the worm would not touch it ; there are several modes proposed for preserving wood.



Mr. Peter Jeffries.  
 12th June, 1844.

3453. What proof have you that that process protects the wood?—I have no proof myself, but they state that it does. I believe there is no proof of it, but they could be either made of wood or of metal, and I think the metal could be so prepared that it would not oxydize.

3454. Supposing you had 36 metal tubes have you any estimate of the expense?—No; I have not made an estimate of what the expense would be.

3455. What do you suppose it would be?—Perhaps it would be 2500*l.* to 3000*l.* each.

3456. If your plan were adopted of removing the pier from Cheeseman's Head, would not the shingle, which has been so inconvenient for years and centuries past, be increased rather than diminished?—Certainly not; I would refer to my former evidence to show, that that would not be the case. Besides my opinion is, that the shingle is local and does not travel as it is represented; that it is thrown on the beach and dragged off by the receding of the waves when the wind blows on the shore, and that it is driven along the shore when the wind blows from south to west, or from the north-east to south-east when the wind comes from these quarters, and may be said to be raking the coast, throwing the shingle upon the advance of the wave and drawing it down on the waves receding; that it is local, may be assumed from the fact, that it is abundant on the west side of Folkstone Bay, whilst on the east side of that bay it is not to be found, nor is it to be found at the eastward of Shakespear Cliff, whilst that round the south Foreland on Deal Beach is of totally a different character from that in Dover Bay; and I think that a very large portion of that shingle could be removed, so that there would be very little ill effect experienced from it afterwards. It could be either taken up in land or taken up and barged away. I think that the harbour could be made sufficiently large, or rather that the present harbour could be so enlarged as to afford shelter for ships of war, all that will be required.

3457. Without a harbour in the bay?—I think without a harbour in the bay.

3458. How long have you entertained this notion of floating breakwaters?—For several years.

3459. How long do you think your cables would stand without being changed?—I inquired at the Trinity House how long those lasted upon the Goodwin Sands; but I do not recollect how long it was.

3460. Were you examined before the Shipwreck Committee?—No, I was not; I was before Sir James Gordon's Commission in 1840, and my name appears in his Report.

[ *The Witness withdrew* ]

Capt. Sir S. Brown,  
 R.N.

Captain Sir Samuel Brown, R.N. re-examined.

3461. (*Chairman.*) With reference to your examination of yesterday, be good enough to explain the model of the breakwater which you have now produced?—Of course I can only enter upon the general features of the plan; and upon some future occasion should be happy to describe more particularly the mode of construction.

3462. Is it a floating breakwater?—No, it is a fixed breakwater, intended for the ridge of a sand-bank or shoal water on the coast, wherever it may be required. The front elevation which is opposed to the sea is 20 feet in height from the ground, and supposed to be in 18 feet low water, spring tides.

3463. (*Lt.-Colonel Alderson.*) What is the scale of the model?—Half an inch to a foot; the back elevation is 42 feet above the ground, and would consequently be about 10 feet above high-water level, spring-tides.

3464. What is the distance from the front to the back?—64 feet on the inclined plane, and the angle about 30 or 35 degrees. The length of the base is 100 feet?—It is a section of 100 feet, or any desired length.

3465. What is the base?—56 feet. The frame is constructed of bronze plates or bars, six inches wide, and one-fourth of an inch thick. The sloping bars A are fixed on edge, and are riveted throughout to the vertical bearing bars B, transversely on the section, eight feet apart; and the longitudinal bars C, are riveted by flanges to the heads of the bearing bars, eight feet apart. D represents the diagonal bars, or shores, supporting the bearing bars. E F are waling pieces passing all round the structure. There are three lines of those waling pieces.

3466. Are they the same size as the uprights?—The whole of the bars throughout the framing are of one uniform dimension. The oblique bars are strong trusses, to prevent the frame from warping or twisting, passing from corner to corner. There will be a series of those trusses throughout the interior and the bottom of the frame, which are not visible in the model. The bottom of the frame will be constructed of transverse and longitudinal bars, to which the vertical bearing bars, and the diagonal shores will be riveted. There will also be various horizontal trusses to stiffen the bottom. G G are blocks of granite, 15 inches deep and 6 inches thick, fitted in edgeways between the heads of the bearing piles, to form the upper course of the breakwater.

3467. How are they fitted in?—They are notched into the edges of the sloping bars, and corresponding holes being cut in the ends of the stones, and the longitudinal bars; they will be further secured by copper bolts, H H, on blocks of the same dimensions, resting on the second tier of sloping bars; and I I are the third or lower courses which becomes successively breakwaters according to the state of the tide; K is a gangway or foot-path of granite (which would be railed in) extending to the whole length of the breakwater, which would be accessible at all times of the tide by means of steps or ladders between the inner bearing bars. A sufficient number of iron or copper cylinders or tanks are proposed to be attached to both fronts, and to the ends, to displace a sufficient quantity of water to float the section to its destination where



it will be moored to buoys till the tide ebbs, when the structure will take the ground, and the cylinders be disengaged by stop-ropes or chains. It is to be observed that the granite blocks will all have been fitted and numbered to their respective compartments, and there will be no difficulty or loss of time in replacing them when they are conveyed to the spot M. On the left side is an inclined plane, formed of cork, representing the lower tier of the breakwater. It may be made either of cork, fascines, or other substance.

3468. Do you mean that either may be used?—Yes, any durable substance that will resist the concussion of the sea will answer, but granite, on account of its strength and specific gravity, is preferable. The compartments on the right-hand side of the model contains two courses or layers of these fascines, saturated in coal tar; these fascines placed in ledge rows like steps, would form as effectual a breakwater as any solid material, and would be cheaper than any other filling-in; indeed the employ of these materials, being equally good in principle, becomes a question of comparative cost and durability.

3469. If the fascines, cork, or other substance, were used, the granite would not be required?—Certainly not. I will now beg to state that the weight of the bronze frame to complete 100 feet, being a section or length of the breakwater, would be 35 tons. The cost 100*l.* per ton, viz. 3,500*l.* for each section. The granite ledges, 1,800 running feet, 6 inches by 15 wide, at 2*s.* per lineal foot 180*l.*, together 3,680*l.*

3470. Is that all the estimate?—That is all the prime cost of the section; to which should be added the expense of transporting it to its destination—

	£.
Fixing the ledges of granite . . . . .	100
Superintendence and Contractor's profit . . . . .	500
Brought over . . . . .	3680
Total expense constructing and laying down one section or length of 100 feet . . . . .	4280

consequently a nautical mile and a half of the proposed breakwater on Dover Bay, averaging 30 feet at the outer front consisting of 90 lengths, would cost 376,300*l.*, and occupy about 18 months to two years in the execution.

3471. (*Chairman.*) Have you any particular place in view in proposing this plan?—I have in my mind the Brake; since I made that section, I have heard that the sand has shifted, but I cannot believe it possible that any change in the position of the main body of the shoal has taken place that would affect the stability of the breakwater. There may have been some new deposit, or partial shifting of the edge of the bank, which has altered the relative distance of former soundings.

3472. Provided the sand is known to have shifted, should you feel confident in undertaking the work?—No; it would be extremely injudicious to attempt to place the breakwater where the sand is known to have shifted.

3473. Do you think any slight erection would tend to fix it where it is?—No; if the whole bed of the sand has shifted, it must all go together.

3474. Do you think a sand that is half a mile wide and three miles long will all shift together?—I think it must be a mistake.

3475. Are you aware that the Trinity House have published a public notice to the world that the sand had shifted half a mile in towards the shore?—I am not aware of it; but under such authority I would not recommend it to be constructed upon the Brake, which is much to be regretted, because there are few situations where a breakwater would afford better protection to the general trade of the country.

3476. Supposing there was water there, what would you say?—I would say that the proposed breakwater on the ridge of the Brake to the extent of a mile and a half would form an asylum roadstead sheltered from every wind.

3477. Do you think the channels could be deepened to the northward?—I should think not. The continual process of dredging would clear it away no doubt; but if it is sand, I apprehend it would soon fill up. With respect to Dover Bay, it does not appear that there are any difference in the sounding that can be defined as a sand-bank; but there is shoal water, and a gradual increase of depth to a considerable extent from the beach, well adapted for the proposed breakwater, commencing at 4 or 5 feet low water, which would leave a passage for boats, and larger vessels as the tide flowed; and it might be carried out from this commencement in the direction most eligible for the purpose to the depth of 30 feet at low water.

3478. What would you say of a depth of 42 feet?—It is practicable, but it would not be the most advantageous situation. If greater depth than 30 feet low water was required, I would propose to extend it by a few sections of a floating breakwater.

3479. How would you fix the blocks of granite?—I would drill holes through the ends, and rivet them to the bronze plate.

3480. Have you anything further to state?—I should observe that, independently of the important advantages of the proposed system, abstractedly considered, is the facility and expedition with which it can be carried into effect. For example, I should consider it perfectly practicable, with suitable modifications, to construct a breakwater according to the plan which I have but inadequately described in Dover Bay, to cover the harbour. If an extension in the required direction is one and a half mile nautical, it would require 90 sections, the whole of which could be laid down on skids, and launched from the beach.

3481. How long would you be in completing a mile and a half of your breakwater?—As I have maturely considered the system in all its bearings, and being in possession of ample means, I would undertake to complete the work within two years.



Capt. Sir S. Brown,  
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3482. In answering that question do you refer to a shoal water breakwater, or do you refer to a deep water breakwater?—I refer to a breakwater of the depth I have stated, according to the model, on any suitable situation.

3483. You do not propose, in your breakwater, to work at a greater depth than 30 feet?—30 feet at low water. I think it would be perfectly practicable and equally efficient as in shoaler water.

3484. You would not undertake it at a greater depth than that?—I do not exactly say that; it would, no doubt, require greater strength of materials. I think it is possible, but I have not given that subject mature consideration.

3485. What would be the difficulty in building it in six fathoms as well as five?—My present view of the system is that there would be no difficulty; but I would reserve a decided opinion till I have given the subject further consideration.

3486. Supposing the depth of water at the place where your breakwater was to be sunk to be five fathoms at low water, and the rise of the tide to be 17 feet, what would you make the height of what you call the sea front?—The front elevation should be 32 feet 2 inches; and for the back elevation you should just add the highwater mark to that.

3487. The width of your frame, and the length of it, would still be the same?—No. If you require a greater height you must have a greater area for the base, and inclined plane or artificial beach should be at least 80 feet, and the base 70 feet; but the length would remain the same.

3488. Do you think you could do a mile and a half in five fathoms water, according to that increased section, in 15 months?—I should require some extension of time. The model represents the front of the breakwater 20 feet; there is no difficulty in adopting it for a depth of five fathoms at low water, but the work being upon a greater scale, it would require a proportional extension of time and increase of means, which, however, would approximate with the foregoing statement.

[The Witness withdrew.]

Mr. John Mitchell.

Mr. John Mitchell, examined.

3489. (*Chairman.*) What is your profession?—I am an engineer.

3490. Where do you reside?—At Belfast.

3491. What proposal have you to make to the Commissioners?—I have brought with me a model of a battery proposed for the Goodwin or the Margate Sands (*the same being produced.*)

3492. You wish to construct it on piles?—Yes, malleable iron piles.

3493. To what depth do your piles go into the sand?—In that model they are shown 30 feet.

3494. Have you ever bored the sand?—No, not the Goodwin, but I have no doubt from what I have heard of it, and from my long experience in putting screws into all sorts of sand, that we could sink the screw-piles to the depth of 30 feet.

3495. Are you aware that in trying to bore they had not got below seven feet and a-half, and that they broke their instruments in trying to bore deeper?—I did not know that, but I think it would be easy to bore to a much greater depth than that; I think I could do it. My father prepared this model, in consequence of a suggestion when he was examined before the Shipwrecks Committee.

3496. Will you read your own account of your invention?—

*The same was read as follows:—*

“ *Description and Sketch of a Patent Screw-Pile Battery and Light-House, proposed to be placed on a Sub-Marine Sand-Bank. By Alexander Mitchell and Son, Engineers.*

“ The annexed sketch is intended to represent, in perspective, a screw-pile battery and light house, constructed entirely of malleable iron, and having its screw-pile foundation firmly planted in a bank beneath the sea.

“ The principle of such foundations has already been well tested both on the east and west coast of England; off the shores of which have been erected screw-pile light-houses, that have now withstood the storms of several winters, without exhibiting the slightest symptom of insecurity or decay.

“ The stability of such structures depends on two causes:—First, the firm hold which the broad screw takes of the ground, by being forced far beneath its surface; and, secondly, the solid part of the building being placed above the reach of the highest sea, no broad surface is opposed to the free passage of the waves, consequently the structure is not affected by them.

“ The first foundation of this description was fixed in the Maplin Sands by us in the summer of 1838, by order of the Honourable the Corporation of the Trinity House of Deptford and Stroud, at the recommendation of their engineer, James Walker, Esq., F.R.S., and president of the Society of Civil Engineers, who has since erected on it the Maplin Light-house; and though it stands upon a bank of loose sand, many miles from the nearest coast, and exposed to the swell from the German Ocean, yet it is as stable and likely to endure as if based upon a rock.

“ The foundation consists of nine spiral flanches, each of four feet diameter, keyed on the foot of as many wrought-iron piles; these were screwed into the bank to the depth of 22 feet, and, from the nature of the ground, might have been sunk to a much greater depth had it been considered necessary. This house was first lighted on the 10th February, 1841.



“ But the first light-house of this or, indeed of any description, so far as we are aware, that has ever been based on a sub-marine sand-bank, was erected entirely by us, after our own design, in the winter of 1839, at the entrance of the sea reach leading to the town of Fleetwood-on-Wyre.

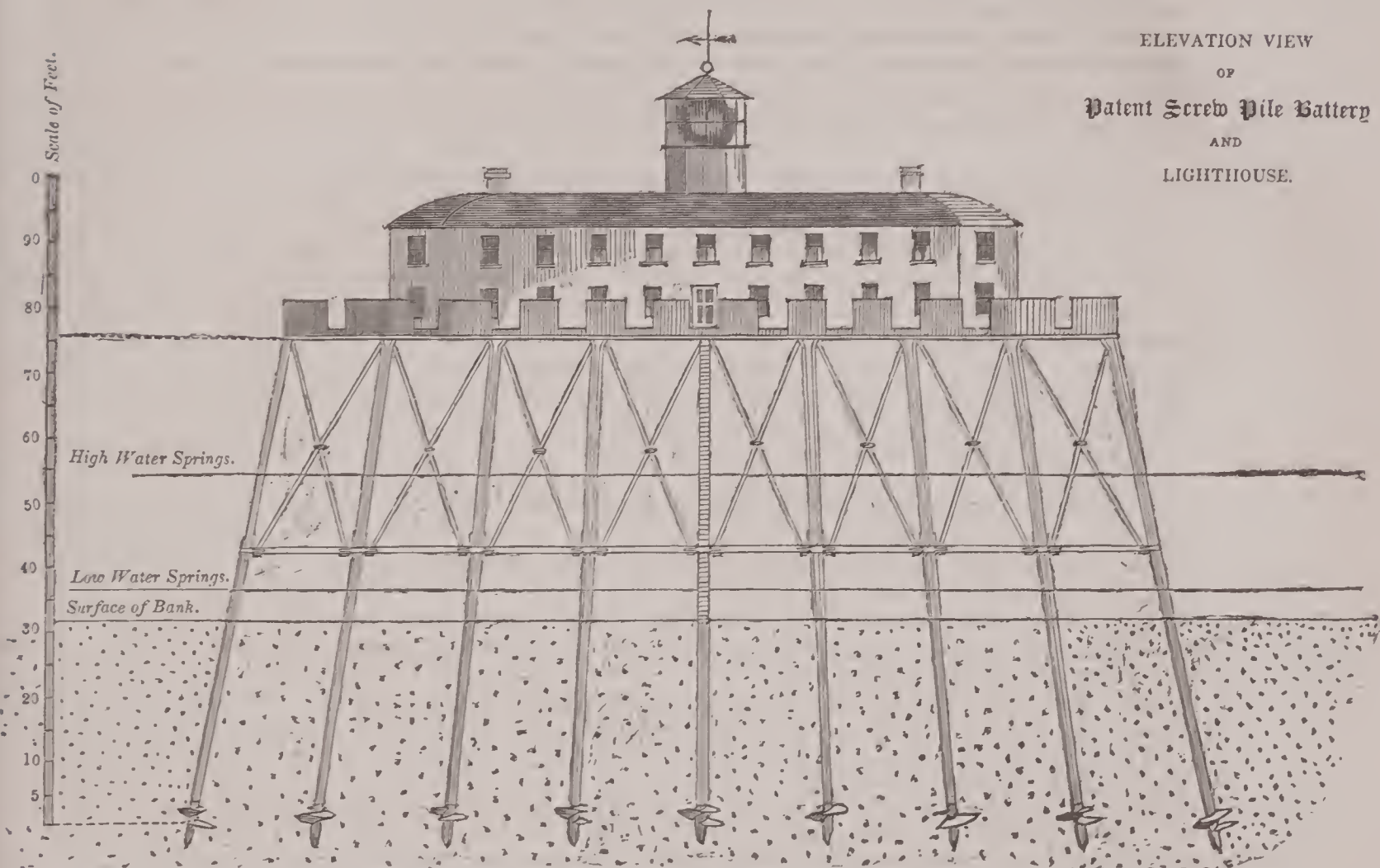
Mr. John Mitchell.

12th June, 1844.

“ This house is now standing nearly four years, having been first lighted on the 6th June, 1840, and, though the material used in its construction is principally wood, a little paint is all that has been required to keep it in perfect condition since the time of its erection, although exposed on the north and west to the swell of the open sea, the tide rising on the columns upwards of 30 feet.

“ We have thought it necessary to enter into the above details, for the purpose of showing with what perfect security many descriptions of work may be placed on sub-marine sand-banks by means of screw-piles; but our attention was especially directed to the subject in consequence of some observations which fell incidentally from his Grace the Duke of Wellington, as Lord Warden of the Cinque Ports, when giving evidence before the Shipwreck Committee of the House of Commons.

ELEVATION VIEW  
OF  
Patent Screw Pile Battery  
AND  
LIGHTHOUSE.





Mr. John Mitchell.

12th June, 1844. *Extract from the Evidence of His Grace the Duke of Wellington, taken before the Select Committee on Shipwrecks.*

“ 5264. CHAIRMAN.—The attention of the Committee has been directed to the subject of a harbour of safety between Portsmouth and the Thames; will your Grace have the goodness to state your opinion as to the necessity for the erection of a new harbour?”—‘ I have no doubt about it. I entertain no doubt that it is absolutely necessary. There is now no security between Portsmouth and the Downs. Dover Roads is a very secure place, in the period of a northerly or easterly wind; but there is no security at other times; but, on the contrary, it is a very dangerous place in a wind from the south-west. They can run for the Downs; but there is no great ease in the Downs; certainly, there is no security in Dover, except from warlike attempts. But I should say that, considering the want of protection from the weather, and from military attacks in the Channel, the trade of the port of London will be in a very precarious situation, and will be a very losing one, in a variety of ways, in time of war, if something is not done beforehand—if some precautions are not taken. Steam-power, in moving ships, has made such progress at present, as that it must have a most material effect in maritime warfare (I use the word maritime warfare in contradistinction to naval warfare) in all future times. If anybody will just consider the advantage the French coast enjoys over the coast of this country, in observation of what is passing at sea; that is, to the southward, they have the sun in their backs; they see everything quite clear; and it is possible, from the coast of France, to calculate to a moment at what period a vessel coming up Channel will arrive at particular points; and they may be in readiness to seize her, at any point which may happen to be unguarded, supposing the vessel to be without convoy, and supposing that there should be no naval means at that point to take care of her. I should say that the trade of the port of London would labour under a great disadvantage if it were found that every vessel coming up from Portsmouth was obliged to come up in a convoy; that she should be shut up unless there were a convoy; and there are no means of providing for that safety except by ports; not one only, but there ought to be, I should say, at least two between the Downs and Portsmouth. I should say one about Dungeness, and another, possibly, at Dover. I have given a good deal of reflection to it, and have thought of it a long while, and that is the conclusion to which I have come; and it is a rational conclusion, for it is founded on what the state of the commerce of this port (which is the great port of the country) will be, by-and-bye, if something is not done.’

“ 5265. Sir *Charles Napier*.—Is your Grace aware that there is a good bay in the Goodwin Sands, called Trinity Bay?”—‘ I have heard that; but I have never been off to it.’

“ 5266. Your Grace states that there should be two harbours of refuge, one at Dungeness and another at Dover. Generally speaking, the trade coming from London, bound westward, may get into the Downs, but be able to get no further than the Downs, and may never be able to make the port of Dover; would it not therefore be better if the harbour of refuge was somewhere they could arrive at, from the eastward, in coming to Dover?”—‘ I am not able to judge of the maritime capacity of the Downs; but I should suppose, from what I see, that the Downs is safe, not very comfortable, but safe as a port; and I believe the holding-ground is good. I think it would not be at all difficult to secure it, in a military point of view, for vessels running in there. I do not mean to say it is impossible to do anything in Trinity Bay. I think it is wonderful what Captain Bullock has done upon the Goodwin Sands; and I will not pretend to say how far those measures might be carried out, and how far they might give further security in the Downs. There is no doubt whatever that a port in the Downs, to give to vessels lying in the Downs perfect security, would be a very desirable object; but I cannot say how far that system of Captain Bullock’s can be carried out.’

“ 5267. In time of war, your Grace is aware that it will be impossible, with steam, for the trade to lie at anchor safely in the Downs.”—‘ There have been instances of privateers coming into the Downs, and taking out vessels; but, now that there is steam, it would be perfectly impossible for 400 or 500 vessels to lie in the Downs. I should say it would be possible to give an increase of military security, so as to give complete security. I should say that it is a secure place in the main; but I doubt if it is a very comfortable place.’ ”

*Report of the Shipwreck Committee on Light-Houses and Beacons.*

“ The numerous wrecks on the north-west coast of Cornwall induce your Committee strongly to recommend that one or more light-houses should be erected on that rugged shore. Towen Head appears to your Committee to be the most desirable situation, as it is in evidence that there is already a small pier near thereto, which might be extended so as to render it a fair harbour of refuge. Models of light-houses have been brought before them by Captain Sir Samuel Brown, Mr. Bush, and Mr. Steward; but, as neither of these has been tested, they do not offer an opinion upon them. Two light-houses, erected by Mr. Mitchell, upon a new and ingenious principle in regard to their foundation, having now stood the test of more than two years (one upon the foot of the Wyre Sand, off Fleetwood, and the other on the Maplin), the Committee do not hesitate to recommend to attention. They feel it right, also, to notice a beacon erected by Captain Bullock, of the Royal Navy, upon the southern edge of the Goodwin Sands, which now has stood two winters; and, having been erected at a very small expense (not exceeding 55*l.*), may prove of the greatest service if brought generally into use.”

3497. (*Lt.-Col. Colquhoun*.) Have you considered the means of applying your method of screw-piles into the sand to the construction of breakwaters?—We have not thought of that; one of the principal advantages of our method of building, is to allow the waves to pass freely without breaking them.

3498. Do you consider it applicable to the formation of breakwaters?—I think it might be used better than other sorts of piling for that purpose.

3499. Have you ever tried to screw piles into shingle?—Yes, the screws go very well into shingle. At Sunderland Harbour we have screwed moorings into shingle, and also at Bristol. Unless the stones are of a very large size, it works its way very well.

3500. How many feet have they gone into shingle?—In the place I spoke of at Bristol, the screws went down 12 feet, 6 or 7 feet of which was through shingle, they were stones thrown



in to prevent a bank from washing away; we have not screwed through stones of a large size, but anything up to the size of your hat, for instance, we can work through well; we can put on very great power, by using capstan bars of great length.

Mr. John Mitchell.

12th June, 1844.

3501. What force do you require?—That depends entirely upon the nature of the ground. Upon the Maplin Sands it required about 30 men, but at the depth of 15 feet, the sand grew so much softer, that I think 15 men would have screwed the piles in the remaining 7 feet.

3502. What did you use?—A capstan head keyed upon the piles with long capstan bars which shipped into it.

3503. How deep did your screws go at the Maplin?—22 feet below the surface.

3504. Was the Maplin Sand dry at the time?—It was occasionally dry at very low ebbs.

3505. Do you mean that you screwed it in at the first motion, was there no gear whatever?—No gear, except the bars, which were 16 feet long each.

3506. Are your piles screwed into one another?—We generally make them in one piece, but where there is a greater length than 50 feet required, we make them in two lengths with a coupling, which admits of their being more easily managed.

3507. Are they hollow?—No, the piles are of malleable iron and solid.

3508. Do you know the maximum weight they would sustain; do you know what weight would cause them to sink?—That must depend upon the nature of the ground, but the screw at the foot of the pile being of such a great breadth would sustain an enormous weight, we have never known any of them to sink yet.

3509. The work on the Maplin has not sunk at all?—Not the least.

3510. (*Lt.-Col. Alderson.*) How is the foot of the pile armed; is there a little screw?—There is a small screw or opening bit to it.

3511. What is the diameter of the screw?—Those in the model represent four feet screws.

3512. Have you ever tried chalk?—No.

3513. Do you think that by reducing the thread you could get through chalk?—If the chalk was not very hard, I think it might be done.

3514. If you were to screw into chalk, would you require an enlargement at the foot of the pile at all?—No, the size of the pile would be sufficient.

3515. Are you of opinion that upon the Goodwin Sands you would only have sand to bore into?—I cannot say, but I think from the form and position of the bank, that it is a very great depth to the chalk. I am of opinion that the chalk underneath the Goodwin Sands is a continuous line with the chalk that is found in the Downs and outside, and I believe that the sands were formed by countercurrents or eddy caused by the formation of the coast.

3516. You have engaged to make a foundation upon that principle for the Trinity House for a beacon?—Yes.

3517. (*Capt. Washington.*) Supposing a battery to be erected upon piles similar to the model now upon the table, and it was struck by a ship, a laden vessel, do you think the strength of it is sufficient to resist the blow?—I think some of the piles might be bent, as they are of malleable iron, by a large vessel coming against them with great force; but as they are intended to be of great strength, a foot in diameter, I think the vessel would be very soon knocked to pieces, so as to make her do very little injury to the structure.

3518. You think the vessel would be more injured than the piles?—Yes.

3519. If a collier were running down Swin with a south-west gale, and were to run against the Maplin Light, what would be the consequence?—It would do a great deal of harm, but I think the lighthouse might be protected, so that a vessel should not strike against it; there might be a chevaux-de-frieze of strong malleable iron piles, so that the vessel would hit that first, and that would destroy the vessel.

3520. (*Chairman.*) Would not the expense of that be enormous?—The expense would be considerable, but if the support of that house were made much stronger, and of malleable iron, a vessel, unless she run her bow in amongst them, could not do it a great deal of injury. When vessels in thick weather, which is the time of greatest danger, come near enough to enable the crew to see the lighthouse, they try to avoid coming in contact with it for their own safety. A vessel came in contact with the Fleetwood Screw Pile Lighthouse, which we built, before it was finished, and struck it with considerable force, but did no injury to it.

[*The Witness withdrew.*]

Adjourned till to-morrow at 12 o'clock.



Thursday, 13th June, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Capt. Vetch, R.E.

Captain Vetch, R.E., further examined.

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3521. (*Sir H. Pelly.*) In your printed Memoir on Havens of Safety, you point out the Downs as a site of great importance for the formation of one; state whether you mean the Great or the Small Downs?—The boundary between the two anchorages is not easily defined, but the site I have proposed comprehends the Small Downs, or anchorage lying to the west of the Brake, together with the space bounded on the south-east by a line drawn from Deal Sand to the Hook. The proposed haven will also embrace all the shoal ground northward to the Quern and Dike Banks.

3522. What would be the total area of the enclosed or sheltered site, and how much of it would have four fathoms and upwards?—As far as the published charts and my other especial information furnish data, the whole enclosed area within low-water mark would be about 8000 acres, of which 2000 acres would have a depth of four fathoms water and upwards.

3523. How much area would there be of five and six fathoms respectively?—Speaking under the same reserve as to the sufficiency of my data, the area of five fathoms and upwards would be 1200 acres, and of six fathoms and upwards 170 acres.

3524. How do you propose to enclose and shelter this haven of safety?—On the south-east by an iron screen about 2260 yards long, extending from the Deal Sands towards the Hook Bank, leaving an entrance and tideway open between the south west end of the screen and the shore at Deal Castle of 1200 yards, and leaving another opening 1800 yards wide, between the north-east end of the screen and the Hook Bank; this last would constitute the main entrance facing the Gull Channel and the Goodwin Sand. The iron screen will be capable of adjustment, so that no more obstruction need be offered to the flow of the stream than is necessary to intercept the undulations of the sea; and as I propose the adjustable part of the screen shall be supported on stout iron frames, a space may be left between the foot of the screen and the bottom of the sea, so that while the undulation is destroyed at the surface, the tide stream may still have a scour upon the bottom, and the amount of this aperture below will also admit of any desirable adjustment. I propose to secure and strengthen the screen at either extremity by a solid pier 100 yards long, and at every distance of 240 yards to insert a solid pier of 20 yards long.

3525. How is the shelter to be obtained for the proposed haven on the east side?—By taking advantage of the Brake Bank, and constructing upon it a spinal embankment in a north and south direction for a distance of about  $3\frac{1}{2}$  miles. The average depth of water on the above distance being only about two fathoms, the cost of this work would not be comparatively heavy. A complete breakwater would thus be obtained, which, besides rendering the water much smoother inside, would prevent the bank from shifting, and would render the stream inside more constant and direct in its action, and undisturbed by gales of wind athwart its course.

3526. In your printed Memoir you propose prolonging this breakwater north to the Race Bank, do you consider that absolutely necessary?—I consider it of great importance to continue it about half a mile further, in order to terminate it on solid chalk ground, and so effectually to intercept all lateral streams or currents that tend to injure a constant and direct flow through the haven, and to give the termination an outward cant, and the mouth a funnel-shape.

3527. Would not such a prolongation have the effect of cutting off the Cliff End Channel?—It would have that effect, but I propose to substitute a new channel or entrance more suitable to the action of the tide-streams, and much more convenient for the shipping.

3528. How do you propose to protect the north end of the Haven?—I propose to take advantage of the Quern Bank, and to construct a pier upon it 700 or 800 yards in length; and if that is not sufficient to add a similar work of smaller extent on the Dike Shoal; but I would endeavour not to interrupt the tide-way in that quarter more than absolutely necessary for shelter, as otherwise there would be some danger of a deposition of silt in the haven from the obstruction to the stream.

3529. In the printed Memoir you have also proposed to prolong the breakwater on the Brake southward to connect with the Hook Bank, do you consider that essential?—I consider that prolongation would render the haven more complete and give a shelter to the deep anchorage against north-easterly gales; but as the Gull Bank, the North, and Middle Bars, serve to intercept the sea in that direction, perhaps this prolongation may not be indispensable; but such a prolongation furnishes the funnel mouth to the tide stream, which becomes more requisite when otherwise obstructed by screens and piers.

3530. What are the number and nature of the entrances to this proposed haven?—There would be four openings or entrances: one 1200 yards wide between Deal Sand and the shore, for small craft; the depth at present is three fathoms, but on the construction of the screen it is highly probable the action of the tide-streams would deepen it possibly to four fathoms. The next entrance, that at the Hook, would be 1800 yards wide, this faces the East and the Gull Channel, and also the Goodwin Sands. This is the main entrance, and quite contiguous to the great extent of deep anchorage inside, and it would therefore prove very accessible to vessels passing through the Gull Stream in either direction, and would be equally easy to the egress of vessels with either a north or south destination; it would also be considerably sheltered by



the proximity of the Goodwin Bank, to which it is opposite. Lastly, there would be two entrances at the north end of the haven, abreast of Ramsgate, one on either side of the Quern Bank; and those, though shallow at present, might, I conceive, easily admit of deep channels being cut in them, and at no great expense; that on the inner side I propose to furnish with a channel three fathoms deep; and that on the outer or east side of the Quern I propose to furnish with a channel or cut four fathoms deep. This last being a substitute for the Cliff End Channel, this would only entail deepening the present channels about one fathom each across the shallow chalk ground; any sand or silt then standing in the way would, in all probability, be carried off by natural action.

3531. What advantage would this new channel possess over the Cliff End Channel?—The channel of the new entrance would be in the direction of the stream of the tides, and the northern portion being scooped out of the chalk edge, a new and clean channel and deep scour would be presented to the direct action of the tide currents, the effects of which would in all probability extend to the Small Downs, and connect that anchorage with the new entrance by a channel at least four fathoms deep. The Cliff End Channel lies apparently to the immediate south of the chalk edge and parallel to it, to which circumstance it no doubt owes its existence, as from its soft bottom, though in a lateral direction, it yields to the action of the currents, which the chalk edge resists; but the lateral action through the Cliff End Channel serves to divert the stream, and scour from their natural direct and useful course, and tends to create eddies and banks. The new channel is in the useful and natural direction, but the bottom being hard, a passage or communication of sufficient depth in the direct line of the tides can only be effected in the first instance by an artificial cut. Again, the direction of the Cliff End Channel right athwart the run of the tides is most inconvenient for vessels; and not only in that particular, but from being at right angles with their course, whereas the new channel would be equally convenient, both as respects the run of the tides and the course of the vessels passing from the Small Downs to the north, or *vice versâ*.

3532. Are the works you have now enumerated all that are necessary to establish a complete haven of refuge?—All that are necessary to shelter and enclose it, and to provide commodious entrances. The construction of batteries and arming them would be an ulterior consideration. I have mentioned, that by deepening new entrances at the north end, a deeper scour would be introduced through the haven, and I may now add, that I am of opinion that if the Sandwich Flats were embanked, that measure would much assist in promoting the same object, and of procuring a better scour and greater depth of water over the whole interior of the proposed haven. The embankment of the Sandwich Flats may nevertheless be considered as an independent work which would repay itself from the value of the land reclaimed.

3533. What do you consider would be the cost of the proposed works exclusive of the Sandwich embankment?—Adopting the principle of iron framings, &c., and taking every advantage of shoals and sand-banks, the cost of the necessary works would be small as compared to the old modes of proceeding; and I have estimated, roughly, that the amount required would be only about 750,000*l.*; but without recent, especial, and detailed surveys, it is difficult to attempt any great accuracy of estimate; but allowing for the worst state of the case and for all contingences, I have some confidence in believing that the cost would fall short of one million sterling.

3534. In what time do you consider the works could be accomplished?—I should allow one year for preparation and three years for execution; if great celerity was required.

3535. You have proposed certain works on the Goodwin Sands, will you state the precise objects of those, and say whether they have any immediate connection with the haven in the Small Downs?—The Goodwin Sands are to the Great Downs or outer anchorage what the Brake Bank is to the Small Downs or inner anchorage, namely, a natural shelter or break-water from north-east to south-east; but I should deem it impossible to form the Great Downs into a haven of safety; nevertheless, I expect several important advantages if the works I have proposed on the Goodwin Sands can be successfully carried out; but I am well impressed with the difficulty of all works on such a site, and have only speculated on the probability of success, and therefore wish it may be clearly understood, that the project of providing a haven of safety at the Small Downs is entirely independent of the success of any erection on the Goodwin Sands; and all I would recommend in respect to the latter at first would be, some experiments to test the practicability of the principles proposed to be applied there.

3536. Supposing your project in respect to the Goodwin Sands to prove successful, what benefit do you expect to derive from converting them into a dry bank or island?—These sands being situated in the line of a great trade and navigation, and in the immediate vicinity of frequented anchorages, they have been found at all times very dangerous to shipping, from the great extent of shoal water they present, and from the indraught upon them by currents across them; and as they must be almost constantly under the lee of vessels passing on one side or other, it follows, that in thick and blowing weather, they will prove sources of solicitude and danger to the numerous vessels on that track; and my project consists in an endeavour to raise the crest of the Goodwin Sands above high-water mark, so as to render them at all times visible, and to stop the indraughts and currents across them.

3537. Do you expect to derive any other advantages from raising the crest of these sands above high-water mark?—The conversion of the Goodwin Sands into a permanently dry bank would much improve the shelter to the anchorage of the Great Downs, at all times of the tide, from north-east to south-east, and would completely shelter the entrance to the haven of the Small Downs; but if the Goodwin Sands became an island, it would always present a safe lee-side where vessels in distress might find a shelter; and though I do not expect they

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would resort to its lee-side as to a haven of safety or roadstead, yet in so great a thoroughfare for vessels it must often happen that a ship in distress would be saved from destruction by daring to run close under the lee of a dry bank, which they could not venture to do in respect to the Goodwin Sands under present circumstances. Again, on the weather side of the island vessels would not have the indraught to contend with, and even if they grounded, the crews would in all probability be saved, and the vessel stand a much higher chance of being got off.

3538. If a harbour of refuge were to be formed off Dover, would it not prove equally useful with one at the Small Downs?—Any harbour of refuge formed off Dover, being necessarily a work entirely of art, must be of comparatively limited extent from the great cost of construction; and being small, the entrances must be narrow in proportion to preserve shelter inside. The harbour proposed in the Harbour Commission Report of 1840, at Dover, encloses an area of 400 acres, whereof about one half or 200 acres is of four fathoms water and upwards. At the Small Downs the anchorage contains 2000 acres of four fathoms water and upwards, and the main entrance is 5400 feet wide, that is, the anchorage would be 10 times more extensive, and the entrance seven or eight times wider than at the proposed harbour at Dover. The main entrance to the haven of the Small Downs is sheltered by the Goodwin Sands; that at Dover is quite exposed. The completion of the necessary works off Dover would be apt to cause an accumulation of silt and shingle inside. The completion of the works at the Small Downs would tend to deepen and improve the anchorage there, and prevent deposition. The drift shingle ceases at Sandown Castle, but is very active near Dover. From the narrowness of the entrances to the proposed harbour at Dover, and from their being situated in an active tideway, I should fear that they would not be easily accessible to a number of merchant-vessels if caught in a gale of wind, particularly in thick weather. Steamboats and men-of-war would probably find no difficulty in gaining access, but to numerous traders of bad sailing qualities and indifferently manned, I should not conceive the proposed harbour at Dover would prove so serviceable in foul weather, and still less in time of war, when whole convoys are seeking shelter at the same time. Dover does not appear to me to be situated at so critical a point of the coast for vessels *en route* as the locality of the Downs, which forms, as it were, a neutral port for vessels that are prevented pursuing their voyage (either up the river or down the Channel) by westerly gales; from the violence of which at the Downs they are completely sheltered. On the other hand, the coast at Dover is quite exposed to a south-westerly gale, so that vessels caught in one and coming up Channel would prefer passing Dover and running into the Downs; while vessels proceeding from the river would much more readily fetch the Downs if caught in a south-wester, but might find much difficulty in reaching so exposed a point as Dover, and to attempt which they could have no inducement; yet the south-west gales are the most violent and common off that part of the coast. I am therefore of opinion that no harbour at Dover could obviate the necessity of a haven of safety at Deal for our mercantile marine. If for war purposes only, Dover, as a site, is perhaps better calculated both for offence and defence, and it is better situated as a packet station; but the great mercantile marine of Britain must resort to the Downs; and where our trading ships collect there ought also to be our ships-of-war and batteries to protect them.

3539. Would you then propose to leave Dover entirely in its present state?—As a packet-station and as a shelter to a few war-steamers, it would be desirable to construct a safe landing-mole for all times of tide, and to erect so much of a pier or breakwater as would give sufficient shelter to a requisite number of war-steamers.

3540. You have given an opinion that a sufficiency of scouring-water could not be procured by artificial means, at Dover, to keep the proposed harbour of refuge there free from silt. Will you state, more in detail, your reasons for that opinion?—The shore at Dover is so occupied by houses, and backed in by rising ground, that a basin or reservoir for scouring-water would necessarily be of very limited extent, or, in fact, would be restricted to the devoting of the whole of the present tide-harbour and pent to that purpose; in all about 25 acres, or one-sixteenth of the harbour proposed to be scoured. At Ramsgate, the outer harbour contains about 30 acres, and the scouring-basin about 15 acres, or one-half; and this is not found too much. Indeed, if it were not found convenient to keep a quantity of silt in the harbour, for vessels to ground upon, the scouring-water would be insufficient to keep the harbour clean; but the bottom of Ramsgate harbour, being hard chalk, much assists the action of the scouring-water; and, from the harbour at Ramsgate being shallow, and the scouring-water being flushed off near the time of low water, the discharge acts directly against the silt; but, at Dover, a discharge of water from the tide-harbour would act upon the silt on a bottom of four, five, or six fathoms. It is easy, therefore, to judge how comparatively small must be the effect of scourage under such different circumstances; and I may roughly state it as follows:—Difference of proportional areas of scouring-basins eight times greater at Ramsgate. Difference of effect, from nature of bottom, is two to one in favour of Ramsgate. Difference from depth of water, in favour of Ramsgate six times; that is, the scouring effect of Ramsgate would be 96 times greater than at Dover, by using the whole of the present harbour and pent as a scouring-basin; but if the proposed harbour at Dover was much diminished in the extent necessary to meet the objects stated in my last answer, then the scouring effect would be augmented in the same proportion nearly.

3541. (*Chairman.*) Will you have the goodness to mark upon the chart the part which gives you four fathoms over 2000 acres at the Small Downs. [*The Witness marked the same upon the chart.*]

3542. Does this refer to Captain Bullock's recent survey?—I got my information from Captain Bullock's recent survey, therefore it includes his amendments.

3543. (*Lt.-Colonel Alderson.*) You speak of an iron screen, capable of adjustment, so that no



more obstruction need be offered to the flow of the tide than is necessary to intercept the undulation of the sea; have you any model to show that?—I have not.

3544. Then will you be good enough to describe it?—I have a rough drawing here, which will perhaps give an idea of what I mean. [*Producing the same.*]

3545. Will not the machinery by which you propose to adjust your screen be liable to be out of order?—The adjustable rods will be all fixed by collars and keys, and their position cannot be altered unless by workmen sent for the express purpose.

3546. (*Chairman.*) Are you aware that the Brake Sand has been ascertained by Captain Bullock, the Admiralty surveyor, to have shifted in bodily half a mile towards the shore, and that the change is shown in the Admiralty chart?—I have heard that stated, and I have also heard it contradicted; but it is certain that either the bank has shifted half a mile in half a century, or that the chart of 1795 was then incorrect as it is now.

3547. Is it known to you that the Commissioners lately examined the Brake anchorage, and found throughout less water than they were led by the reports to expect?—I had not heard that fact; but, from the inspection of Captain Bullock's recent survey, I understood that would be the case.

3548. (*Sir Howard Douglas.*) You have alluded to works of defence; is it possible to erect any works of defence on the breakwaters you have now proposed?—The breakwater on the Quern, and most of that on the Brake, would be filled up solid, and therefore any extent of battery could be constructed on them; and, in regard to the screen, the solid termini and piers would permit of the same application, so far as they extended.

3549. (*Chairman.*) Have you examined the Small Downs and their locality, yourself; or are your suggestions founded on information collected from others?—I have been repeatedly along that coast, and sailed over it. I have not made any soundings myself. I should say they are founded both on personal inspection and on information.

3550. Have the goodness to state what has been the nature of your personal inspection?—My opportunity of personal inspection has arisen from a residence at the locality, by examining the coast repeatedly, and by sailing over the ground; but I have not made any soundings or measurements; those I have taken from the Admiralty charts, &c. Lastly, I collected information from every pilot and coast-guard man I came in contact with.

3551. Have you heard that, in skirting round the buoys laid down by the Trinity House within the anchorage of the Brake, the vessel we were in got into much shallower water than we expected?—I heard as much; and I think it a highly probable circumstance, because the Brake, being entirely exposed to the north-easterly gales, must constantly tend to the west, unless fixed as I propose, by an embankment, and unless counteracted by works to procure a more active and counteracting current inside.

3552. Is it known to you that, for a very long distance throughout the anchorage in question, the vessel we were in was in such shallow water that she would have been aground in any part of that distance if it had been low water, while the chart from which you profess to get your information showed an ample depth at low water?—The chart which I consulted shows a depth of only two fathoms at low water, on the Brake Bank, and towards the head of the bay near Ramsgate; but that chart is founded on the recent survey of Captain Bullock; and the anchorage to which you now allude cannot be what I have referred to. From the action of natural circumstances, I can very easily conceive how the material of the Brake Bank has been thrown over from the outer or exposed side to the inner and sheltered one, and how the deep channel on the inside, shown on the old chart, has been so much filled up; and all the works I have proposed are for the express purpose of preventing the Brake Bank from further shifting, and also for the purpose of restoring what is now so much wanted—a deep-water channel inside of it. If the crest of the Brake Bank can be raised above high-water mark, the material will be prevented being carried across to the inner side, and deposited in the channel; and if a pretty strong current can be brought along the anchorage-ground, we shall have the same deep water brought back again.

3553. Are you aware that the corporation of the Trinity House, with their accustomed regard to the interests of the commerce of the country, have issued a printed public notice to all the maritime world, that this great shift in the Brake Sand has taken place?—I have not seen that notice.

3554. Supposing the fact to be as stated, are you prepared to propose to the Commissioners to recommend an outlay of nearly a million of money in such a situation?—It appears to me that if this embankment upon the Brake had been constructed 50 years ago, this deterioration of the anchorage could not have taken place, because the sand cannot move in a dry state; it is the water flowing over and across the surface of the bank which enables the matter to be carried over and deposited in the channel inside. But this lateral shifting of the Brake Bank is so perfect an illustration of what I have stated in my Memoir, that I beg to be allowed to quote the following paragraph; and I should also beg to submit for consideration, that if the Brake Bank is travelling westward, at the rate of half a mile in half a century, whether it is not important to take every reasonable means to prevent so great an evil as that circumstance is creating:—

“Those sand-banks, emanating from the deposition of matter in the eddy of a great stream, and resulting from great natural features of the adjoining coasts, may be considered the most permanent in their form and extent; because so long as the eddy-ground exists, it will offer a place of deposit to the matter with which the stream is charged, nor will the matter be easily removed again from thence; but a long narrow bank, deposited in a tideway parallel to the current, occupies almost an accidental site, and may owe its immediate origin to some accidental nucleus, as a wreck; and, therefore, if a slight adventitious cause was the origin, adventitious causes (such as a great storm in a vulnerable direction)



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may alter them. Thus, during the last half century, while the Goodwin Sands do not appear to have altered materially in form and size, I learn from the late able investigations and surveys of Captain Washington, R.N., that the long narrow tideway sand-banks off Yarmouth have undergone considerable and frequent changes; but it would appear, as might have been expected, that the quantity of material remains nearly the same; and that, while one bank, or one portion of a bank, has lost matter, other banks or other portions have gained in the same proportion; and thus partial oscillations arise in those banks that owe their particular situation to no very determined action in the selection of the spot. The long narrow form of these banks also renders them more easily disrupted or breached by storms running across them. It therefore becomes the more important, in respect to sand-banks of this species, which are used or required for breakwaters to anchoring-grounds, that the aids of art should be called in to give additional fixity to the location, and to strengthen their form against the attacks by storms; and any particular bank fixed and secured by having its crest raised above high-water mark, while it would no longer be liable to be spoiled of its own materials, would be apt to absorb and retain the spillings of adjoining banks, and become ultimately a dry bank or island."

3555. You speak of your work along the Brake being inexpensive, because it will be generally in a depth of only two fathoms; will not a considerable part, at the south end of the Brake, be to be carried on in five and six fathoms water?—In five fathoms.

3556. For what distance?—About 1800 yards. But I have already stated that, though desirable, this portion is not indispensable.

3557. You propose to cut channels on each side of the Quern Bank, so as to get a depth of three fathoms on one side, and four fathoms on the other. By what process do you propose to deepen the channels?—It would require a steam-vessel, with a particular apparatus for breaking up the chalk and dredging it.

3558. You naturally anticipate much advantage from the cuts you propose, but, in point of fact, is there not always a risk of mischief in altering the natural direction of the tide?—The ridge of chalk at present opposes the natural direction of the tides. These cuts would permit them to continue in what would be their natural direction, but for the chalk ridge.

3559. Is there no apprehension, from the direction you give to the tide by the cuts, of carrying the sand to the harbour of Ramsgate, and forming an accumulation?—I conceive just the reverse, that the scour would then become considerably greater abreast of Ramsgate Harbour.

3560. Then where do you suppose it will be carried?—A breakwater being constructed along the Brake Bank, all travelling matter would naturally deposit on the lee side of that barrier, and the deposition would consequently be most apt to form over the surface of the Brake Bank, and what was deposited along the edges would be thrown up, when they became the weather side, against the line of sustentation thus provided.

3561. You have said in a previous answer. "The channel of the new entrance would be in the direction of the stream of the tide, and the northern portion being scooped out of the chalk edge, a new and deep channel and deep scour would be presented." Will you make out where that chalk edge goes?—(*The Witness marked the same.*)

3562. You speak of estimating roughly that the cost of your proposed work will be about 750,000*l.* Have you any specification or detailed estimate of the work?—I have not, but I have gone into the estimate roughly in different ways, and I have come to nearly the same result by different modes of making it.

3563. Does your estimate of 750,000*l.* include all those cuts?—It does not include the cuts.

3564. It does include the works upon the Quern?—Yes.

3565. Is it known to you that in the last three years the average number of vessels that have gone into Ramsgate Harbour amounts to 1600, exclusive of the craft of the port, and that 460 sail have been there at one and the same time?—I have not seen the returns of those particulars during the last three years.

3566. If only a limited sum of money is to be spent in harbours, do you think it would be judicious to expend it in constructing an artificial harbour within two miles of a port capable of giving such extensive shelter, and to neglect other more prominent and important parts of the Channel?—Ramsgate Harbour is a mere tide harbour, where small vessels can only enter from half-flood to half-ebb, and must take the ground at low water, and where East Indiamen and other large merchant-men cannot find water at any time. A harbour of refuge, I consider, ought to be a harbour where vessels of all sizes can freely enter and depart, and ride at anchor in safety at all times of the tide; and no vessel, *en route*, would enter Ramsgate Harbour so long as they can remain safe in the Downs.

3567. The material you use is chiefly iron; what duration do you suppose iron will have in the situation you propose in the wash of the salt water?—I have proposed iron to be used as framings, either independently or filled in with concrete. If used independently as in the proposed screen at Deal Sands, it might be expected to last a century at least; but used as it would generally be with concrete, I see no reasonable limit to the duration of the structure.

3568. You state that you should require one year for preparation and three years for the execution of your work; what number of days of interruption do you calculate upon working in a situation so exposed to the sea?—Upon my previous examination I had the honour to present to the Harbour Commission a memoir which I had written on the construction of these piers, and accompanied with a calculation of the time required to execute them, and as the process is simple and easy I will take the liberty of referring to it. "In the construction by iron framing it is reasonable to assume that a frame of four feet may be set each tide, and by working from two ends 16 feet per diem ought to be performed in good weather."

3569. What allowance do you make for the interruption by bad weather?—I believe I computed at the rate of about four days in the week of uninterrupted work.



3570. Two days of interruption?—Yes.

3571. It appears that, on an average of six years in constructing the Plymouth Breakwater, the interruption amounted to 183 days in the year. May we not reckon on the probability of a similar interruption in the Downs?—At Plymouth Sound the materials had to be conveyed in lighters or vessels, but upon this principle the pier goes on progressively from one end to the other, and the materials are brought up from the pier itself, independent of the state of the winds and waves.

3572. In your printed work you make a sensible and very striking observation and suggestion. You say, “Notwithstanding the apparent feasibility of the plan proposed to fix these ever vexed and vexing sands, expectations may be disappointed, and nature refuse the remedy; but if such conciliating and gentle means are rejected, it may be doubted if more violent measures will succeed.” You then go on and say, “It is estimated that an experiment on a sufficient scale may be made for 500*l.* or 600*l.*” As you admit your proposition to be experimental, and open to doubts as to its success, will it not be wiser to take the precaution you have so well suggested, and make a trial on the scale you propose, rather than at once spend nearly a million of money on the experiment?—Unquestionably; I beg leave, however, to observe that the remark quoted applies to the mode of treating the Goodwin Sands, and that the mode proposed to be adopted on the Brake Bank would be a very different one; there I should propose to construct a regular pier with platform, and push on constantly from the end, and bring up the materials on the platform along the finished portion of the pier; and the rods would be made to penetrate at once to the required depth; but, nevertheless, I consider a satisfactory experiment on the Brake Bank as essential a preliminary there as the other would be on the Goodwin Sands.

3573. You would propose to make an experiment on the Brake Sands, on a small scale, first?—Yes.

3574. To what extent would you go in making that experiment, to the extent of 500*l.* or 600*l.*, or what amount?—I should consider that a fair experiment on the Brake Bank, upon the principle proposed, would require about 300 yards, and that the cost may be taken at 60*l.* a-yard, making 18,000*l.*

3575. Can you suggest any spot where an experiment on the limited scale you proposed of 600*l.* would be sufficient?—I think the Goodwin Sands, as Mr. Walker proposed, viz., the site for a beacon, would be very suitable for the description of work I have proposed for a sand, dry at low water.

3576. You think that site for a beacon on the Goodwin Sands, as before suggested, would be a sufficient test?—Yes, for the class of work proposed there.

3577. Is it not considered that the Downs is the place where a ship so far finishes her homeward voyage, that when she arrives there she has passed all the hazards of the Channel, whether with reference to the risks of navigation or of an enemy’s cruizers?—No doubt a merchant-man on gaining the Downs is comparatively safe from any enemy’s cruizers, but the Downs in its present unprotected state is not free from danger.

3578. Do you mean by “unprotected” to refer to military protection?—To military protection and shelter from weather.

3579. Is it not, in your opinion, in the narrow part of the Channel, between the South Foreland and Portsmouth, that ports of refuge are most needed?—The narrowest part of the Channel would be the most accessible to an enemy’s cruizers, but the vessels must take their departure from a place of rest, and that place of rest, I conceive, ought to be a place of refuge, and the Downs is both a place of departure, and it is near the narrowest part of the Channel, and is important in respect to the estuary of the Thames and the North Sea.

3580. Looking at the chart between the North Foreland and Portsmouth, and directing your eye to the opposite coast, where do you think it would be most judicious to place squadrons for the protection of the trade, and the purpose of watching the opposite shore?—Not being a nautical man, I have a great difficulty in giving an opinion upon the position of a squadron, but Dover being the most prominent point, would admit of a more ready departure for steam ships-of-war.

3581. Your system of giving shelter to harbours appears only to admit of dealing with sands; have you no other proposition for a breakwater?—I have a proposition, to which I have already referred, and which I laid before the Admiralty, by which piers may be run out into deep water on the same principle, and those piers having been so run out, in skeleton shape, may be filled up and consolidated to any extent which might be deemed desirable. I was informed by the secretary of the Admiralty that when this Commission was formed the model and plans should be sent to it.

3582. Have you ever thought of any plan on a less expensive scale, so as to improve the anchorage in front of Ramsgate at a cost which would come within the compass of the large revenue of the Ramsgate Commissioners?—It appears to me that a comparatively small part of my proposed works might be constructed off Ramsgate to render the tidal stream more effective abreast the harbour, and very much to improve the depth of water there.

3583. Have you ever landed on the Goodwin Sands?—No, I have not.

3584. You propose to make the Goodwin Sands an island?—I conceive that it is very likely that, with a comparatively small outlay, the sands might be made to accumulate and become a dry bank or island. I have been amongst them, but not on them.

3585. Have you ever constructed any works such as you propose to erect in the Small Downs, or are your plans and specifications made in your study?—My plans and measures have not been tested by practice; they are new; but my study has been the book of nature, and I have endeavoured to read it rightly, and I have been led to form a strong opinion that none of our existing modes of construction are commendable or advisable, either at Deal or Dover, and that



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if anything is to be done there we must look to new contrivances or discoveries, all of which will require to be tested by satisfactory experiments previous to adoption, and among such new plans I respectfully submit my own, but shall be the first to wish to withdraw them when some more suitable method is proposed.

3586. How long would you have your experiments tested before you considered the Government warranted in laying out a million of money?—I should consider that one winter would be sufficient to test the stability of the principle. A million of money can only be expended gradually on such a work; but even so, I should be the last to advise the adoption of any general or extensive measure upon a new principle without previous and satisfactory experiments.

3587. (*Mr. Walker.*) Of what metal do you propose to make your rods for the screen?—Of iron.

3588. Of what size?—Two inches diameter.

3589. Solid or hollow?—Solid, though in some applications I have contemplated using hollow rods or tubes of a large diameter filled with composition.

3590. What is the size of the rods that form the triangular framing at right angles to the stream?—Seven inches wide by one inch thick.

3591. The external rods that form the triangle or outside of the frame, and the horizontal braces, are those referred to?—The external bars are seven inches by one inch, the horizontal rods two inches in diameter, the horizontal bars four inches and a half by three-quarters of an inch.

3592. By what means do you, in deep water, lay the bottom horizontal bars, and the other parts which are under low water?—It is intended for deep water, and I propose to construct the screen in sections of 50 or 60 feet long, and to float them out in lengths, and drop them into their place, and then bolt them on to the sections previously laid down.

3593. (*Lt.-Colonel Colquhoun.*) You state that four years would be required for your proposed construction on the Brake Sands, namely, one year for preparation and three for execution; supposing your experiments successful, could not the period of completion be accelerated?—By working from a greater number of ends, the work might be accelerated to any extent required.

3594. (*Captain Washington.*) Will you be good enough to explain the nature of your screen?—It consists of a triangular framing of stout iron, coming to an apex a little above high water; those frames are bound together and supported by horizontal bars of the same metal, and in the centre, or from the apex a row of perpendicular bars pass down to the bottom of the sea. Those rods, which form the effective portion of the screen, may be either placed close together or at any required distance apart; and they may be either allowed to touch the surface of the bottom or to stop short at any convenient height for the purpose of bringing a scour over the bottom and preventing deposition.

3595. Your screen being placed across the tide, is there not a fear that shoals will grow up under it?—The screen is proposed to be placed slightly oblique to the tide, and by keeping the rods forming the screen a short distance above the bottom, a scour can be introduced there which would prevent the accumulation of any matter near them.

3596. Is the south-western end of your screen connected with the Deal Sand, or do you leave a western entrance?—It rests on the Deal Bank, leaving an in-shore passage for the tide with three fathoms water, and 1200 yards wide.

3597. (*Chairman.*) Will you inform the Commissioners what your proposal to the Admiralty for a fixed breakwater, to which you adverted, was?—I will send to the Commission the written statement of the nature of it, together with a model and drawings.

3598. Have you anything further to state with reference to your proposition to the Admiralty?—I have nothing further to state than that which is contained in the paper I have alluded to. I consider it particularly applicable if it is proposed to construct a harbour of refuge where there is a liability to silt, for you may leave as much of those piers open as you please to the action of the currents.

3599. Would it not, in admitting the tide, also admit the shingle?—It would certainly admit the shingle if left open where the belt of shingle travels, but my principle gives the facility of making the pier solid where required, which will be its general condition; and the exception will be to leave it open, or in a skeleton form, in places where it may be desirable to introduce a passage for the stream.

3600. Is the plan which you have proposed to the Admiralty applicable to an artificial harbour at Dover?—I consider that it is particularly so, in reference to the purpose of avoiding the deposition of silt.

3601. In point of construction, do you consider it suitable, the whole of the proposed artificial breakwater at Dover being in from seven to eight fathoms at low water?—I conceive there is no reasonable limit to the depth of a breakwater on any other mode of structure in practice to which my principle would not be equally or more applicable, but of course with the depth the difficulties of each form of structure would increase.

3602. You would have no hesitation in proposing your plan for the formation of a harbour at Dover?—The locality of Dover is a difficult one for any kind of structure; but if it be determined to encounter the difficulty, I know of no mode of accomplishing the same within a reasonable time and expense upon so feasible a plan as that which I laid before the Admiralty, or by means of iron caissons, as pointed out in my former evidence; and I should either choose between these two modes or combine them.

3603. Would it be attended with inconvenience to you to state a proposition for a harbour at Dover?—I shall be happy to give the subject my best consideration, and to furnish an outline of what appears to me most practicable. If it is decided to have a harbour at Dover, having a screen at the west end would admit of the scourage, and give shelter at the same time; whereas without that you can hardly do so without damaging the shelter or admitting the silt.

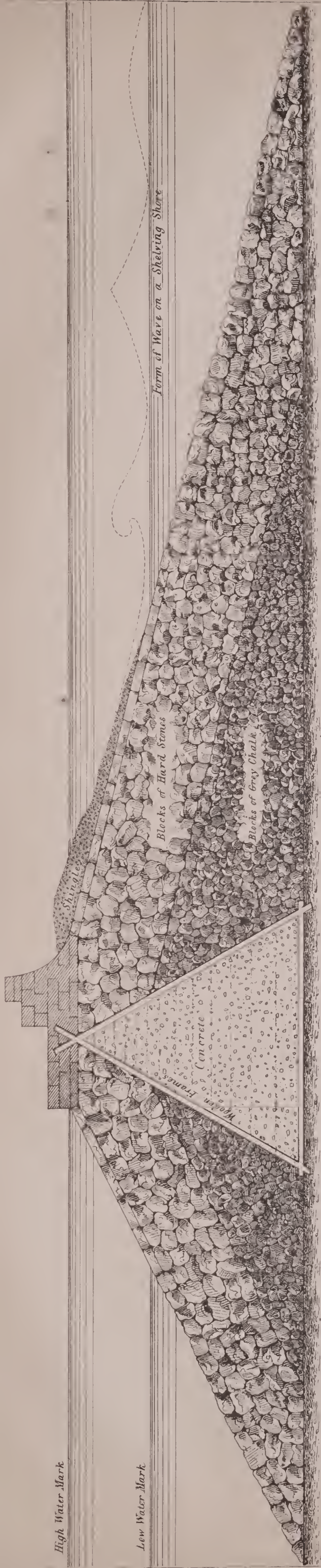






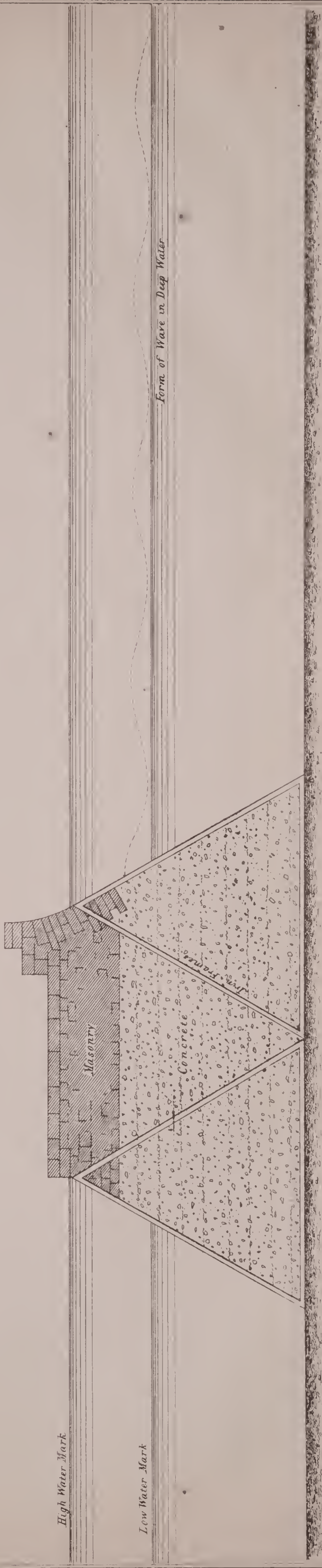






Section of Piers for proposed Harbour at Dover by William Cubitt Esq<sup>re</sup>

Scale, 30 Feet to 1 Inch.



Proposed Alteration on the Section of Mr. Cubitt, by Captain James Vetch, R.E.







3604. Will you consider the proposition for a harbour at Dover with reference to seven fathom water at spring-tides?—I shall be happy to give every attention to the case, and state the results.

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3605. (*Mr. Walker.*) In your evidence you have stated that you consider that the erection of an iron screen at the south end of the Brake Sand would have the effect of improving and increasing the depth of water in the harbour, which will be formed in the Small Downs, be kind enough to state how you conceive that effect will be produced?—I have been misunderstood. The iron screen is for a very different purpose from the work on the Brake: it is a work of necessity to give shelter; but instead of improving the scour of the tide, it must, to some extent, diminish it; the breakwater on the Brake Bank, on the contrary, would have the effect of confining the tide-stream to a direct and constant action, and of preventing its dispersion from north-easterly or other gales coming over the surface of the Brake Bank.

3606. But inasmuch as you protect in some degree the openings into the Small Downs by the iron screen that extends north-east from Deal Sands, do you not also decrease the current in the Small Downs?—That is just what I have been stating. The screen will intercept the flow of the northerly stream to the extent of the surface it interposes; and to compensate for that I have proposed that the south end of the breakwater on the Brake should have a cant outwards to receive and conduct a larger portion of the stream; also I have left a tide-way between the screen and the shore at Deal, and an opening between the foot of the screen and the bottom of the sea.

3607. Do you think that in the current of water within the Brake, that is, the water in the Small Downs, where you propose to make your harbour, the effect of your works will be to increase the depth by means of increasing the tidal water?—With the exception of the screen which is necessary for shelter, and which will interrupt the stream in the least possible degree, the effect of the other works will be to increase the depth not only by augmenting the flow of tidal water, but by giving the same a more direct and constant action in one channel. I think if the northern and southern cants are executed, the Sandwich Flats embanked, and the cuts made through the chalk at the north end, there is no doubt a much greater degree of effective tide will flow down the present channel; but at the northern end you can extend the cant to any reasonable extent you please. It may be carried out to the north-east end of the Spur Bank, and a great body of the southerly set of the stream conducted through the proposed haven.

3608. (*Adm. Dundas.*) Supposing that you had a breakwater coming off from the Deal Sands in front, and from the Brake, without any other work, would that give sufficient protection to the anchorage?—Yes, that would protect the anchorage; but I should be afraid it would damage the tide-way, and it is important to keep the anchorage clear.

3609. In what way do you think it may damage the tide-way?—In proportion to the extent of the surface the screen opposes to the stream; it would, from its position, tend to throw the northerly set of stream into the Gull Channel, and therefore the necessity is greater for enlisting every other means of improving the scour.

3610. What would be the inconvenience if the tide were turned as you suppose?—It would diminish to that extent the scour over the anchorage.

[*The Witness withdrew.*]

Adjourned.

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Admiral Sir T. BYAM MARTIN, in the Chair.

*William Cubitt, Esq., examined.*

*W. Cubitt, Esq.*  
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3611. (*Chairman.*) In order that you might be the better prepared to answer the questions put to you, I believe a copy of the questions has been sent to you?—Yes.

3612. Supposing it to be decided to convert Dover Bay, Dungeness, or other places into a harbour, with the sea front in seven fathoms at low water, having regard to economy, and to its speedy execution, so far as the same may be consistent with solidity and permanence, will you give the Commission your opinion as to the mode and materials for constructing the work?—The answer to the first question would depend in some degree on the consideration of the second question, which goes to the principle of a breakwater.

3613. Considerable doubts being entertained as to the slopes, and particularly the sea-slopes of breakwaters, the least likely to be damaged by the action of the waves, you are requested to read a statement we have obtained from Lieutenant-Colonel H. Jones, of the Royal Engineers on this important subject, and to give us your opinion?—There are two or three modes of constructing a breakwater. The simplest is tumbling large stones into the sea, as Plymouth Breakwater and Kingston Harbour Pier; another mode is building in water with large stones, by means of the diving-bell; another by building caissons, filling them up partially, and floating them into their berths, and sinking them, and completing afterwards, either in or about them. All those modes are very expensive in deep water, and the expense increases much faster than in proportion to the depth; that is to say, pursuing the same mode, the expense will increase in proportion to the square of the depth multiplied by the length, as near as may be. The square of the depth of one breakwater multiplied by its length, will give a certain number representing cost; the square of another depth multiplied by its length, will give a proportional number, representing the cost of it; and thus the two may be compared. Touching



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Colonel Jones's proposition, I agree with him, that in deep water, a perfect upright face from the bottom to the top would be the best, if of solid material, which could not wash or break away by the action of the sea; a solid face, for instance, inasmuch as the waves would have less range upwards by that than by any other means. But at the same time, such a breakwater, I conceive, would be the most expensive to construct. Touching the expense, I have not been able to go into the expense; nor, in fact, have I had time to get written answers prepared to these questions. But I formerly gave some evidence on the subject to some other Committee or Commission, or to the Treasury; I forget which, but I think the Treasury.

3614. Respecting slopes?—Respecting the construction of breakwaters generally, and one kind in particular; that is, to construct a breakwater quickly with caissons, to enclose the space; and then to fill up outside and in with rubble to form slopes, as in the common breakwater; so that the advantages of an enclosed harbour might be obtained in a short time, at a comparatively small expense, but it would require subsequent completion to render it permanent and durable. I could not give clearer evidence now on this particular subject than is contained in my letter to the late Chancellor of the Exchequer; but that went to less than seven fathoms of water. So that, if the cost of that was represented by 36 for any given length, say a foot or a yard, seven fathoms would cost 49 or 50 in round numbers. I believe that a breakwater with upright faces might be built absolutely in caissons 40, 50, or 60 feet high, completed to that height, upon Colonel Jones's principle (upright faces), built in caissons, and sunk in place, and completed by building within-side the caissons, after the tide has got below its top. For instance, we may imagine a breakwater with upright sides to be 60 feet high. We could build a cube vessel 60 feet high, with four sides and one bottom, make it perfectly water-tight, planked, and timbered, and it would swim; and in that might be built a stone fabric, either solid or hollow, perfectly upright faces, and exceedingly strong and well built; and that would float when loaded to a third of its whole depth, that is to say, it might be built in 20 feet thick. It would swim, and might be towed out and sunk, and then it could be completed in place. It would never move; it would be a solid stone cube of 40, 50, or 60 feet, or whatever dimensions might be advisable.

3615. Does the plan you are now stating partake in any degree of Mr. Brenmer's proposition?—No; I had my plan in my mind long before I saw Brenmer's proposition. It would be possible, building and sinking one, to build and float off, and sink, and complete another close alongside it, and another, &c., in 40, 50, or 60 feet lengths.

3616. Do you not, in your letter to the Chancellor of the Exchequer, mention 200 feet?—That is quite another plan; I am describing how it is possible to build a solid stone upright wall, taking the least possible materials, and getting the greatest possible quantity of strength.

3617. Do you propose to have a protecting slope in front of the wall?—Not at all in that case, because the breakwater would be a perfect thing in itself—an upright face like a wharf, which is a difficult thing to construct out at sea.

3618. Will you state what in your opinion would be the expense of constructing on your plan?—The expense I have not been able to go into at present; but I think I may venture an idea, that a breakwater in seven fathoms water is sufficiently above high water to answer all its purposes. A breakwater, in general, could not be thoroughly completed under something like 1000*l.* a-yard.

3619. In either of those places?—I think a good breakwater in seven fathom water, on whatever plan it was made, to be good, would not cost less than 1000*l.* a-yard.

3620. In what depth of water?—Seven fathom at low water.

3621. Taking the rise of the tide?—Everything connected with making a breakwater to enclose seven fathom in low water; we must then add the tide, and the height above high-water mark, which would be more or less according to the plan pursued.

3622. You are aware that the tide rises 18 feet in one place, and 8 feet in another?—If you make a breakwater with a long flat slope, you would have to rise it higher out of the sea to prevent the waves getting over its top than one with an upright face.

3623. In constructing caissons for any marine purpose, which do you consider the best, wood or iron?—Wood for large ones.

3624. What do you suppose would be the duration of wood?—I do not know, but I never use them at all, if the duration is of any importance; that is to say, the way I should use caissons would be to last 10, or 15, or 20 years; probably they would require to remain that time, and after that time it would be a matter of no consequence what became of them. I will give an instance. In the plan I gave Mr. Baring, the caissons were proposed to be built in lengths of from 100 to 300 feet, according to circumstances, and floated into place partly loaded, filled up with sand and shingle as the cheapest materials, and made solid; they then have a form and weight that no sea will move at all; they would then, as far as the breakwater goes, be a perfect breakwater to all intents and purposes, and they would last as long as the caisson lasted. It was then proposed to fill them up with flat slopes of rubble stone outside, that is, on the sea side and the harbour side, to form a solid mass, and carry that on subsequently to high water; and as soon as it was done, it would be of no importance if the timber should be annihilated. The duration of the timber does not form much of an element in the thing. Again, if we were to build a pier with upright sides in caissons floated out, they would be built so well, that the whole of the outside casing might be stripped off; for the duration of the timber should be of no consequence.

3625. In following out the plan you proposed to the Chancellor of the Exchequer, what slopes should you give to your breakwater?—As a minimum, four to one, I stated, on the sea side.

3626. Would you, if you were to prepare a breakwater on that plan, still persist in having



that slope, or would you have a much more upright slope?—I should have the flattest slope I could between high and low water, and it would form itself into a slope perhaps rather more upright below low water. I think the Plymouth breakwater in the form it has taken, in spite of anything to prevent it, will give the best idea of what a breakwater would be in heavy seas. Slopes of two or three to one knock to pieces very fast in a heavy surf, and beaches of nine or ten to one stand the sea the best.

3627. Has Plymouth breakwater suffered great damage in the progress of its building to a very serious amount in point of expense?—Yes.

3628. Therefore, what I understand you to propose is, to take it as it is shown in its present shape, and not as it was originally laid down?—As it now is shown, for we have the benefit of experience.

3629. As the sea has cast it, so you would adopt it?—I think that is the form in which it would be most likely to lie with stones of the same size. I am speaking now of the part below low water, which takes its own shape. Above low water we could do what we please with regard to shape; but the great difficulty and the great evil attending making breakwaters in the open sea, is the deterioration which the work suffers during its progress. Now the piers of Kingston Harbour, which I frequently advert to because they are a very good case, were, I think, 15 or 16 years in building. They never stopped, but they used to be knocked to pieces very much at the tips where the stones are put from the waggons, and it was those contingencies which led me to think about forming a breakwater in lengths of about 100 feet or perhaps more, extensively built and sunk at once. The instance in which I tried caissons was on a small scale, but they answered the purpose exceedingly well.

3630. If you were called on now to construct a breakwater, is that the plan you would propose, to make the masonry and sink it perfect?—If I was to make a breakwater with sloping faces like that which is described in the Report on Shipwrecks, page 261, I should pursue the means there stated. I have not since built anything of the kind on a large scale, and I do not at present, from subsequently thinking about it, know of a better mode, because I feel satisfied that we can construct timber caissons sufficiently strong to withstand all the action of the sea, and to last several years. I feel satisfied we can build them sufficiently large to answer the purpose; I also believe they are manageable at that size, inasmuch as we could tow a first-rate vessel into the roadstead, and lay her in any direction, and scuttle her, and sink her; and we could do this thing so much the better because we could scuttle the caisson by means of wells and valves and contrivances for the purpose which I did adopt for those that I sank, and they sunk remarkably well; they were in 100 feet lengths.

3631. Where was that?—At a small harbour which I made on the coast which never was finished, and never answered as a commercial speculation, but the caissons, so far as the mode of making them went, answered very well; they answered their purpose.

3632. You would feel no difficulty in seven fathom water in dropping the caissons with accuracy in their place?—None at all, because I should weight them down to four or five fathom before I sank them.

3633. If caissons are used for such work, what length do you recommend as most conveniently manageable, and in every respect the best?—For long triangular caissons in lengths not less than 100 feet; but were I to build an upright solid pier on caissons, I should make the caissons, as near as may be, cubes of the total height; but, at all events, cubes of the low-water height, because when we are above low water we can build without the need of a caisson at every tide.

3634. Is it your opinion that the hard chalk with a facing of granite is desirable to be used in the construction of breakwaters?—I have some little doubt about it. If it could be carried on quickly and covered soon with harder stone, I should say a great deal of the best chalk might be used; but pitching the chalk into the open sea, as breakwaters are usually made, I do not think it would make a good job; we could not be always sure that it would go into the right place, and it is not equal to stone; but if it could be built in and immediately covered, so that the action of the sea could never get to it, then it would be as good as any other material so placed. For instance, if we were about to build an upright breakwater or pier with upright faces, and in square caissons, then the hardest chalk might be used in the hearting of the work exceedingly well, and so might bricks and cement, and all the cheaper modes of building.

3635. Will you be good enough to give your opinion on the various sketches now put before you, showing the lines of the proposed harbours, together with such modifications of the same as you may be prepared to recommend?—Taken abstractedly, any of them are good; and if they could be made, would be very useful harbours; the larger the better, and for that reason the largest would be the best.

3636. Where would you recommend the entrance to be?—The entrance would be best towards the middle and at the most projecting point. Some of these, I think, I had a hand in scheming, and some not. I approve entirely of an enclosed harbour, being, as I understand, the best. There are two principles upon which I think a harbour at Dover may be constructed. One principle is a close harbour, and to that I assent. I close it up at the west; and a close harbour so made would be the best, considered as a harbour; it would be the quietest, and possess every other good property but one; and that very evil property is the property which made me draw a breakwater and not a closed harbour. Do what we will, I am afraid, on the south-east coast, as soon as we close the harbour it will begin to silt up, therefore a close harbour is the best harbour so long as its bottom keeps in the right place. To obviate that difficulty, and to do it in a way which could be remedied if not approved of, I drew this as a breakwater with sufficient openings to let in an indraught and sufficient sea to

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prevent the silt depositing on the bottom. The proposition was with that view to have the openings large enough so that there might be both a run of tide enough through it, and sufficient action to have the properties of a good harbour as a roadstead harbour, and sufficient motion to keep it from filling up, and that is the point to which the whole essence of making a harbour must be directed, so that it will not fill up, and so that it will be quiet enough; and between the two it is difficult to draw the line.

3637. It has been stated that you approve of the suggestion of Captain Beaufort and Colonel Thompson for making it with only one entrance?—Yes, I do; and that would make the best harbour.

3638. If it was made with one entrance only, can there be no run of tide?—No.

3639. Is it not objectionable on that account?—It is not objectionable on any account, except the one I mentioned, that of its being a still-water harbour, the water will come in muddy and go out clear.

3640. Will not the other entrance at the eastern end tend in some degree to diminish by making a draught of tide through it?—The mere entrances, I think, are not enough for that, and I think the two entrances would do little or nothing with that; they would not let in even wave enough to keep the water in motion, even in rough weather. It is the nicest point and the greatest difficulty attending the making of harbours. I did not state to them my reasons; they put to me the plain question, “Do you object to closing this up?” and I said “No, I think it would make the best harbour by closing it up.” I have since that time learnt how they do fill up.

3641. What do you think would be the effect of keeping the bottom in a constant state of disturbance on the ebb-tide by any process?—The effect would be exceedingly good, but no process, I think, would answer the purpose and pay the expense.

3642. Not to lift it up, but to keep it in a state of agitation?—I could imagine a fleet of steamers going across and across every ebb-tide, and stirring it up; but it would be exceedingly costly, and would very much interfere with everything going forward in the harbour.

3643. Could it not be effected by harrowing or anything of that kind, and constantly working upon it?—It would effect the purpose, but it would be too costly, and interfere too much with the business going on in the harbour.

3644. Are you in favour of a double entrance or not for the convenience of getting out?—I am.

3645. By entrance was meant also a passage for water to give, if it might do so, some movement?—Yes, but by being closed at the west there would always be the quietest water and the greatest deposit where the motion is most wanted, that is, at the western end. These openings in so large a harbour would give a very little in draught.

3646. Which entrance do you most approve of?—The middle entrance, a little westward from the middle. I should take the entrance at the most projecting point, wherever that may be.

3647. In order that the shingle may pass more readily?—Yes, that is one reason; and I think it is also best to enter with wind a little scant.

3648. Do you not think that ships coming in with a heavy gale of wind would have a greater command of the anchorage at the western entrance than in the middle?—They would have a better choice of ground, no doubt. The plan attached to the report of the Harbour Commission of 1840 has three entrances; one to the westward, one in the middle, and one to the eastward; but in sending my report and plan to Mr. Baring, I laid it down as a breakwater with a considerable opening at both ends, so as to cover the bay; and then experience would determine whether it should be closed in at the west or not, because I am sure that would have made a good anchoring ground and quiet water, but not so quiet as to form a deposit. That was the only object I had in view.

3649. Do you think if it was left open as you originally proposed, the shingle would come in in such quantities as would be likely to fill it up?—That was the objection; but I think we could build up a breakwater, for instance, a jetty, into such deep water that the shingle would not get round it. The shingle gets round because the south-westerly winds overpower the north-easterly winds on that coast; and we have had a very strong example of that at Dover this spring.

3650. If you were to build a breakwater as you propose at Cheeseman’s Head, would not that prevent a run of the tide?—It would in a great measure; it would obstruct the fair run of the tide; but I think there would be a sufficient set of tide into it to prevent anything like a deposit.

3651. To what depth of water would you run it out?—Six or seven fathoms.

3652. Would that mode of constructing a breakwater detached from the shore be expensive from having to load vessels and afterwards deposit instead of wheeling out?—Yes. The plan with caissons would be the easiest way of making a detached breakwater; but if there were slopes, it would have to be filled up from vessels; but if an upwright one, it could be built solid at once. It is altogether a very difficult subject, because there is not a single thing by way of advantage that has not something countervailing it.

3653. In the report we got a few days ago from Dublin, it does not appear that the harbour has filled up so much, though there is only one entrance?—Very little, and the reason for that is, that the clear ocean water there comes in clear, quite blue, and here it come in like milk. I know Kingstown Harbour very well. I have watched it tide after tide, and week after week sometimes, and it silts up nothing, I may say; it is imperceptible, in fact; but on this coast, with the mud and the chalk together, all along the shore the water is turbid, and it is very plainly to be seen, especially along the cliffs; and it is due to the breaking away of



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the chalk in a great degree. At Folkestone, which is to the westward of Dover, the cliffs have terminated, and as the flood tide goes from Folkestone to Dover, none of the chalk debris from these cliffs, I believe, comes into Folkestone Harbour; the water comes clearer there than it does at Dover, still the tendency is to silt up. I have had that harbour cleared out to a flat inclined bottom, and since it has been cleared out, in less than one year there is a very considerable deposit from the sea.

3654. What is the deposit?—A yellowish mud, and it is very annoying to see it coming. If a harbour like that will begin to do so and show it so soon (and we know that Dover does it very much), a larger and close harbour, if made equally still, will do it also; and if done to the extent of three or four inches per annum, it will very soon ruin the harbour as a still-water harbour; moreover, I do not think (if we talk of a close harbour) we ought to let the land-waters come into a close harbour.

3655. Then according to your idea we must either be content with a breakwater outside the bay, making it a good anchorage, without being a close harbour, or take the risk of rapidly filling up?—I would begin the breakwater first, which would be a piece of a close harbour, but I dread silting up more than anything else; still I say a close harbour is the best.

3656. (*Sir Howard Douglas.*) What upon the whole is the shape of profile of the breakwater you would recommend as best calculated to resist the action of the sea?—I say again, I believe in deep water, upright; and I draw that conclusion in part from what I have seen and in part from what I have heard and read. In the first place, where the rocks go very deep into the sea on the north-west coast of Ireland, and at some of the islands on the north-west coast, I have seen a heavy sea come rolling in and rise and fall against the upright faces much more quietly than on any sloping beach, whatever may be the slope. I have also read and heard a great deal about coral reefs surrounding the tropical isles, many of them where there is a heavy sea outside, and perfectly smooth water inside the reef, having a perpendicular face outside, and the surface or top of the reef very little above the water. Therefore from those things, and what I have seen with respect to the rocks, I think an upright face of good material is the best. I should have no hesitation in building a solid stone breakwater in six or seven fathom water with upright faces, leaving expense out of the question; and I think nothing would be easier and nothing would be better. Again, if we take the cross sections of a breakwater in seven fathom of water, like Plymouth Breakwater, it will take so many cubic feet of stone for every foot in length, perhaps four times as much as the profile of a solid upright one. Then we might pay four times as much for each cubic foot without incurring more expense; but if we have a better thing, it is better upon the whole.

3657. Then, you think there would be no great difference of expense in the two modes of construction?—Not a great way off, I think.

3658. What is the amount of resistance of an upright breakwater to the action or momentum of a heavy sea or wave compared with the resistance which a sloping breakwater presents in the direction of motion: is it not well known that the resistance to such action in the direction of motion is diminished in a certain ratio, according to the obliquity of the surface struck? The theorem, I believe, is, that it is diminished in the ratio of the cube of the radius to the cube of the sine of the angle of obliquity; and as this is a well-known theorem in oblique forces, I want to know whether you consider that the conditions of the case we are considering, viz., that of erecting breakwaters to resist the action of the sea, are not subject to those laws?—It all comes into the question of resolution of forces. If we lay a face exactly at 45 degrees, and impinge horizontally, it will fly off perpendicularly, there is no doubt; and so in proportion to the sine of the angle; but in an upright wall we must treat it as the action of a wave, and the wave will rise much less against an upright face than it will run along up an oblique face, and it will attain much less height.

3659. Will not the direct impulse of the wave be greater against the upright face?—I think not; because the height to which it rises will be so little compared with the other. A sea would run over a breakwater 20 feet higher than the level of the water in a sea which would not rise above 6 or 7 feet upon the upright face.

3660. For the very reason that the sea would run over, the breakwater itself will receive a lesser shock?—No; because there would be such a small slice of water to go against it. And again, on the same subject, if I were to build a solid breakwater with upright faces, I should always build it as wide as it was high; and I think that would stand any sea.

3661. What would be the expense of that compared with a sloping breakwater?—I have just been endeavouring to explain, although I could not answer, that it would take a much less quantity of material. We could afford to pay so many times more per cubic foot for the work as the section was times in the one case over the other.

3662. Would that depend entirely on the cost of the material at the place?—Yes. I have just said that, if in a rubble-stone breakwater, 1s. a foot would be the price of rough material; and it contained four times as many feet in the sectional area, we could afford to pay four times the price per cubic foot to obtain a solid one.

3663. Would you consider chalk applicable to this purpose in that mode of construction?—No? no chalk for outside work.

3664. You said that an upright breakwater should be as wide as it was high?—We will take 7 fathom at low water, and 3 fathom tide; that is, 10 fathom, or 60 feet. I stated before, I would take the cube of the low water; that is from 50 feet cube; the base and the top would be alike.

3665. Have you read Mr. Cachin's Report on the breakwater at Cherbourg?—No.

3666. Are you aware that in the course of a long action of the sea, the slope of that break-



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water, and the slope of the breakwater of Plymouth likewise, have been reduced to much longer slopes than were originally intended?—Yes; but below water they will not get so flat.

3667. Then is there not a certain degree of slope corresponding to the degree of exposure to the action of the sea, which is peculiarly adapted to resist that action, and to which slope the long-continued action of the sea ultimately reduces any profile that may not be adapted to resist that force?—If we take any material like sand or small stones, or anything which will take a form from the action of the water, and constant action will produce a given form; but if there comes a different state of circumstances, like great storms, and so on, that will change the thing again; therefore there is no one answer that can be given to the question to fit all cases.

3668. Are you aware that huge stones were displaced at Cherbourg?—Yes; which stones would not have been displaced if they had been laid on a good surface with a good joint. The wave which gives the impulse for a time on the stone, is as much as the weight of the stone; that is, if the wave is three times as deep as the stone is thick, and there is a little hole communicating with the under side, so that the effect of the wave could be communicated to the bottom of the stone, the stone would jump directly.

3669. So you think that, notwithstanding that well-known natural effect of the action of the water to reduce the slope to a state of stability, you could construct, by the means you have stated, a breakwater with a vertical slope capable of resisting and enduring that action?—To be sure; because it depends upon an entirely different principle. If we build a wall with good joints, so that the water cannot get in, there will be no tendency to throw the stones one off the other; and the weight of the whole mass being greater than the water, there will be no tendency to lift the whole.

3670. What description and size of stones would you think necessary?—Any size for solid work; and I should say the larger the better. But, to answer the question in extremes, I would observe, that you may build as good a breakwater with blue Staffordshire bricks and Roman cement, of the best quality, as you could with the largest stones; and, as to expense, it would be as cheap as stone. The size of the material does not so much signify when the work is of a particular kind; but when I was asked about the forms the beaches and slopes will take, we must think of them either as solids carefully built, or as masses thrown loosely together; and the same answer cannot fit both.

3671. What precautions would you take with respect to the foundation, so that these breakwaters, constructed by means of caissons, shall be sunk, and so placed that no dislocation as far as it can possibly be obviated, shall afterwards take place?—I will state a case in point. Opposite Dover, when you get into 6, 7, or 8 fathoms of water, the bottom, if you could see it lie dry, would be, to all intents and purposes, as level as the floor of this room to look at, and quite good enough to ground any well-built flat surface of solid matter on it to the size of 50 feet square; and that you might build and ground cubes of 50 feet, one after the other, and build them full up to the top of low water perfectly solid, I have not the slightest doubt.

3672. As you are building on an inclined plane, how do you secure their being upright?—The inclination is so exceedingly small, that you would not perceive it if you were standing upon it. It is not so at the beach, but when we get out we find it as level as the floor; and although you get into six fathoms, and then, after a time, into seven fathoms, it is so exceedingly flat, that if you put a cube on it, the inclination is so slight that it would not be discovered by the eye.

3673. Is that the case everywhere but just west and east?—At the west end, approaching the shore, the inclination of the beach would be greater, and there we should drive piles, or pursue other usual means; but all my remarks of late in building have relation to building an insulated breakwater far out at sea in seven fathoms water.

3674. Are you, on the whole, prepared to give your opinion or advice as to the description and form of the section which you would recommend for a great national work of this description, and will you state what process of execution you would recommend so as to combine economy with celerity of execution, solidity and stability, and the nature of the materials you would employ?—In answer to one-half of the question, I would refer to my report to Mr. Baring, that is, as to the celerity and economy, because my subsequent experience has not taught me anything better combining all those requisites. But to leave economy and go a little more to expense, I think the best thing of all would be a solid stone breakwater or pier in the sea, built with an upright face, smooth and nice from the bottom to the top, and made quite solid. I think that would be the best thing.

3675. By caissons, you mean?—Yes, the caissons being merely made the *modus operandi*, or the way of doing a thing which could not be done without them, because we could build them in short lengths, and sink them so nicely that they would form a wall 50 or 60 feet thick, and 50 or 60 feet high, as long as you please, and everything that was done would be complete in itself. The great object of this particular plan is to produce celerity.

3676. (*Lt.-Colonel Alderson.*) Will you state what time would be required for construction?—I think three years would, to all intents and purposes, form the harbour with caissons in 100 feet lengths, and I gave an estimate of it; and that it would take 10 or 12 years more to complete the rubble stone outside altogether. I think in 15 years a good harbour would be formed.

3677. Do you mean to state that a breakwater constructed according to the profile stated in your letter to Mr. Baring would cost 1000*l.* a running yard?—No. I must answer that more definitely, because, in speaking of 1000*l.*, I took the average of breakwater construction in seven fathoms water, and so I stated. The average cost of constructing the best breakwater in seven



fathoms would not be found to come much short of 1000*l.* a-yard. I believe that I could build one of solid stone for 1000*l.* a-yard, and I will give you my reasons. I will take it to be 60 feet high and 50 feet wide; 60 times 50 is 3000 square feet of sectional area: one yard in length of that would cost 900*l.* at 2*s.* the cubic foot. We could build the caisson, and build it full of the best brick and cement, or stone and cement, for 2*s.* the cubic foot.

3678. You would not build the whole of solid masonry?—Good bonded rubble. I would engage to build the whole at 2*s.* per foot. You could do this thing in seven fathoms water, from 40 to 50 feet wide, perfectly upright. I have no doubt the price I state, 1000*l.* a lineal yard, including everything, would pay every expense.

3679. Including the building of caissons also?—Yes.

3680. (*Lt.-Colonel Colquhoun.*) Will you give us any idea of the time, the maximum celerity?—As to time, it is a difficult thing to state; but there is this merit in the thing, if there be no other, that you could have as many caissons getting ready as you chose; and in every summer, so soon as from the state of the weather you could tow them out and sink them (which is a very short operation), you could get on.

3681. How many of these cubic masses would you deposit in the course of the summer?—I cannot say.

3682. For the sake of your own work, would it be desirable to get on as fast as possible?—Yes. A good deal depends on the mode of setting about the thing.

3683. And a like time for preparation?—Yes.

3684. Will you state the maximum celerity by the caissons?—It is a difficult thing to answer; but I think I could do from a quarter to a third of a mile in the year.

3685. (*Chairman.*) You have said that you prefer a close harbour to a breakwater?—Most assuredly.

3686. Are you aware of the immense quantity of shingle that now travels from the westward to the mouth of the present harbour at Dover?—Yes.

3687. Would not the harbour, if closed to the westward, prevent that shingle entering the present harbour, and the intended one also?—Yes. I had a particular scheme, if I may so term it, for keeping the shingle out of the new harbour; and that was, if the breakwater, or if the main pier lies in six or seven fathoms water, I would then have carried a sunk caisson of solid work, two fathoms high, across the bottom of the opening as a threshold. If the stream of tide was strong enough to draw the shingle along at the bottom, it could not float it in; and the waves would not take it up, because they cannot take it up at seven fathoms water.

3688. What distance from the shore would you have that?—On this plan there is a design in red for a large close harbour with an entrance to the south-eastward, for instance, 1000 feet wide, and in seven fathoms of water. Five fathoms would be enough for the largest vessel to go over at dead low water. The thing being made, the harbour with its open mouth down to the bottom, and everything complete, the shingle accumulates to the westward. The shingle would accumulate till it began, probably, to gather round to the southward in front of the harbour, and would stream, along with the tide, along the front of the breakwater, and would have a tendency to get into the entrance; but I propose to prevent it by putting a threshold at the bottom of the entrance 12 feet high, which may be described as being exactly like a threshold to a door. If the tide be strong enough to draw the shingle along in a stream at the bottom, it could not draw it into this harbour, but would draw it past, and shingle is never lifted by the waves, I believe, more than three fathoms deep on our coast; therefore it would be beyond the reach of the waves at the mouth of the harbour in seven fathoms, but not beyond the stream of the tide, and it would be carried past it instead of going in.

3689. Would it not be very easy to prevent the shingle from accumulating at the entrance by having two or three cones outside, and so by that means draw the shingle into deep water?—No.

3690. Do you not think the sill you spoke of would meet the breaking sea in a gale of wind at the entrance?—No, not at that height.

3691. Would not the sill, if constructed, be a mud-trap for whatever was inside, and prevent its escaping out?—No; because there would not be current enough in the harbour to carry anything out.

3692. Have you any reason to believe that the silt would increase more at Dover from the intended harbour than has been the case at Kingstown?—Yes, a thousand times over, I dare say.

3693. Will you state your reason?—Because I think while it would accumulate to about the thickness of a sheet of blotting-paper at Kingstown, it would accumulate some few inches at Dover.

3694. Did you ever hear of silt increasing where there was shingle?—Yes; it increases in Dover Harbour to the extent of several inches per annum, and it is continually being cleared out. In Folkestone it has deposited nearly a foot since it was cleared out.

3695. Suppose the harbour to be a closed one to the westward, and it was found that silt did increase after some years, might it not be very easy to open such a passage as you describe, and allow the tide to pass?—No, it would not be easy at all, and the passage would require to be so wide that by the time it became necessary to do it the silt would have got so hard that you could not open the passage wide enough to produce the effect.

3696. Are you aware that it is supposed not to be good holding-ground in a part of the intended harbour at Dover?—Yes; but I do not mind that, because if there is not good holding-ground good moorings can be put.

3697. Would not that silt greatly increase the anchorage in the new harbour?—No; because it would be stiff enough to do a great deal of harm, and not enough to do any good.

3698. (*Admiral Dundas.*) Suppose it was necessary to form a breakwater without delay,

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and Government had twenty old ships of 100 feet long, could it not be done by building on those ships in the same manner that you proposed doing with the caissons, in a case of emergency?—In a case of emergency you might, and still the water, and put big stones into it, but it would be a bungling job altogether. A ship is the weakest kind of thing to do that business, whereas the caisson is the strongest thing. The frame of a ship is the best thing to float, but not the best thing to lie still and have the action of a heavy sea against it.

3699. You said the caisson would last 15 years?—Yes.

3700. How long do you think an old ship would last?—I consider that if it lasted 15 years it would be long enough for my purpose.

3701. Do you consider that an old oak ship would not last 15 years under water?—Taking wood as to durability, it might last three times that period; but taking wood as holding together, it would not last at all, it would go to pieces.

3702. What do you fasten your caissons with?—The caissons shown in the report are fastened with iron. The form is absolutely such as to be the strongest possible in which timber can be framed, that is, with three sides. There is nothing so strong when standing on its base, either as a frame, or a form to resist the action of the sea tide, which can be covered and supported with rubble stone to form a breakwater.

3703. What is the price of each of your caissons 100 feet long?—About 6000*l*.

3704. Would not a second entrance to any harbour formed off Dover, for instance, be the means of admitting a current through it, and thereby prevent the deposit that you seem so much to apprehend?—No entrance, as an entrance, would be sufficient.

3705. An entrance to the eastward?—It would not induce current enough.

3706. Would it not, in some measure, prevent the deposit which you seem so much to apprehend?—I think not.

3707. Supposing there to be a principal entrance, and also a second entrance, do you suppose the second entrance would not be the means of admitting a current, and thereby prevent the deposit?—No; the current would not be at all sufficient; there would be a very slight draught between one entrance and the other.

3708. (*Lt.-Colonel Colquhoun.*) As regards the tidal current produced through the harbour, whatever the width of the principal entrance might be, would not the velocity of the current be controlled entirely by the smaller entrance; would not that measure the velocity?—The smaller entrance would be the measure of the velocity, and it would require a considerable portion of velocity of the tide itself outside to keep the harbour clear inside; therefore, except the entrance was as wide as the whole harbour, you could not get the whole velocity; and in proportion as it was less than the whole harbour, you would get a small velocity.

3709. Then, much as you prefer a close harbour for convenience, we are left to the only alternative of having a breakwater in front, according to your notion?—It is a choice of difficulties. That a difficulty does exist of silting up in a close harbour I do not feel any doubt.

3710. (*Mr. Walker.*) As you have referred to the milky appearance of the water opposite Dover, and the silt with which the water is charged, do you or do you not consider that that has lately been caused and increased very much by the sea washing the loose chalk that has been thrown from the cliffs, for the purpose of forming the tunnels and the railway between Folkestone and Dover?—I have not the slightest doubt, that at the time those works were going on, that was in some degree the cause; but I have also known the water before that happened as milky as I ever saw it at that time; and I have also, since those operations, seen it the same. Also, that the great falls of the cliffs themselves, without any regard to the railway works, have caused more debris than all the railway works put together; and they will do so again except where we can prevent it. The point of Shakespear's Cliff will, whenever it falls, produce that effect in a great degree; and one fall from that produces more of it than has even been done in two or three seasons of the railway works. A great portion of the cliffs are protected from coming down altogether. The works may have caused some during the time, but that it existed before and exists after I have not any doubt at all, because I know the one fact and believe the other.

3711. (*Sir W. Symonds.*) The questions which have been put to you have related principally to Dover Harbour?—My answers have principally been with regard to Dover Harbour.

3712. I wish to put a question to you with regard to Dungeness. If a pier-harbour was formed along the coast of Dungeness, would it be liable to silt up as you have stated at Dover a close harbour would silt up?—No, the tide having a free current through it, it would not be so liable to silt up; and the very reason why I proposed to form a breakwater protection to Dover is, that it should not silt up.

3713. Then do you mean to say it would be the same at Dover or at Dungeness by having a breakwater?—I do not say that the tendency to silt up at either place would be the same; but I say a breakwater in any place with a free tide-way between it and the land would be less liable to silt up than a close harbour at the same place.

3714. (*Chairman.*) Are you aware what might be the effect of the shingle in a place of that kind?—It is a very shifting point, and keeps growing out continually, and it is not for me to say what effect the silting in one bay would have in preventing the shingle running.

3715. Does shingle run in seven fathom water?—The point has moved out to my knowledge, and the deepest water is close at the point.

3716. Might not the breakwater there have the effect of preventing that elongation of the point?—I am free to confess I do not know. I have not a sufficiently fixed opinion to venture to answer what the effect on this point would be, knowing its shifting nature. I infer there is an eddy tide in both these bays from the very shoals which are formed in them.

3717. Can you imagine that a breakwater formed along the coast would not possibly have



any effect on the shingle moving towards the point on either side?—Only when it comes near enough to the shore to prevent the action of the wave moving the shingle. The shingle moves along this coast by being lifted and disturbed by the wave, and shifted to the eastward or westward, according to the prevailing wind.

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3718. Independent of the action of the tide?—Yes.

3719. Would you recommend a breakwater to be placed in a situation of that kind with so great a shoal in front?—No, except you can get it further from the shoal; but the instant you get beyond the two or three fathom line it goes suddenly down. The questions arose as to silting, and I still say, whether you take it at Dungeness or take the question generally, that a breakwater outside, with a free tide-way between it and the shore, is not liable to silt.

3720. Does that apply to every place?—It does.

3721. Upon the whole, with your knowledge of the port of Dover and the inconvenience from silting up, do you prefer a breakwater admitting of delivery as much as possible of the stream of tide or a close harbour with two entrances?—As a harbour, if it could be kept clear, a close harbour. It is altogether a matter of doubt. I doubt if it could be kept clear; I think the deposit would accrue fast.

3722. Could not the breakwater secure it from the other evils of motion; would it not make it a quiet harbour?—Quietness in a harbour in these cases is altogether comparative. An entirely quiet harbour is a close harbour. A roadstead is an open harbour, but quieter than an entirely open sea without any protection; therefore it is all a matter of degree. We might take, for instance, Yarmouth Roads or Plymouth Sound.

3723. (*Lt.-Colonel Alderson.*) You have stated that an upright wall would be the best to form a breakwater?—I think it would if built in the best manner and upon a good foundation.

3724. And that a long sea slope has a very much larger sectional area than any other mode of building a breakwater?—Yes.

3725. What is your objection to forming a base of rubble stone to within a few feet at low-water mark, filled in with concrete as you go on by throwing concrete down and building upon that an upright wall, from four feet, say, below low-water mark at spring tides as high as you want to go?—Because I do not see clearly how such a proceeding would answer the purpose. In the first place, putting rubble stone down to the bottom and concrete amongst it, would be a very difficult proceeding; and I do not think it could be made to answer the purpose in a sea where there was constant motion. Except we could get the concrete in solid masses and in enclosures it would not do; and even with that it is not quite the thing to stand the work of a heavy sea. We could not make a good bottom in that way. There is a heavy sea towards the top. Near the surface of low-water is where the action would be; and that would be exactly at the place where we should want the wall to be the best as the foundation for the superstructure. If you resort to rubble at all, it had better be all rubble work; or if you resort to masonry, it had better be all masonry.

3726. Are you aware that you can build on rubble?—I believe the lighthouse at Plymouth Breakwater is built on rubble, but that stood many years before they made the foundation.

3727. Are you not aware that they are building at the present moment at Cherbourg an upright wall upon rubble?—I am not aware of it; I believe that may be done. If a rubble wall has been in the sea, and stood 10 or 20 years, I think it might get solid enough for it.

3728. (*Chairman.*) The subject of a breakwater to enclose Portland Road having been under the consideration of the Commission, you are requested to examine the sketch put before you, and to state your opinion of the same, as regards the direction, and the materials and form you would recommend to be adopted at that place?—It is a very good place for a harbour. I think Portland Road is one of the finest places in the kingdom for an asylum harbour.

3729. What direction do you think the best?—I think the direction has less to do with it than any one would imagine; if you fix the place for the outer end, and if you fix the depth of water for the outer end, it matters little whether the breakwater comes to one point of the shore or the other; it is the simplest case of all harbour making is this Portland Road.

3730. In constructing a breakwater at Portland Road it must necessarily be of a considerable length. Do you think an entrance in the middle or near the shore desirable, in case of the wind blowing hard from the northward; might not vessels find a difficulty in getting out round the north end of the breakwater; or in case of parting their cables, might they have facility of escape instead of foundering on the breakwater?—I think it would do no harm to the harbour, and it might do as a means of exit.

3731. Can it always be filled up if found inconvenient?—Yes, and it would not be large, because it would be to get out and not to get in by.

3732. Would you have in that case two openings, one near the shore and another in the middle?—No; I think one about one-third of the length from the shore would be the best place; it would be suitable for an entrance, and would combine the advantage of one in the middle and one close to the shore, in a great degree; and it would be the cheapest way to make a harbour there, as there is plenty of stone, and all down hill for the run; it would be a pier, and rubble stone continually run in until it was made.

3733. In order to leave an opening, but still get the advantage of running rubble stone out, do you not think piles and a stage built across would be desirable to complete it?—I think we could construct a frame that would carry the waggons; and I think it would be a most beautiful harbour. I have looked at the place as a fancy harbour-maker occasionally, and thought it was a very good situation for one.

3734. With reference to the plan before you of the breakwater at Portland Road, do you see any objection to have a second entrance, either with reference to expense or the difficulty of building it?—I see no objection to a second entrance.



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3735. I understood you to say, that having it one-third out, it met both points?—Yes.

3736. (*Lt.-Colonel Alderson.*) And would prefer a breakwater of *pierre perdue* entirely?—Yes, it is suitable for it.

3737. Do you not face the other slopes of the breakwater between low and high-water mark?—I take that for granted in all cases of rubble breakwater.

3738. Then you think the sea would not interfere with that by having a rubble base?—The general practice is to form the whole of the breakwater with rubble stone up to the full height, and then let it take some years' trial to see how the stones will get settled together, and after a time, again to regulate and pave in among those to make a uniform sort of slope on the outer face after it has got settled.

3739. Would not an entrance of any size cut through the breakwater enhance the expense of the breakwater?—Yes.

3740. Do you think that the expense of building a stage to fill up the space would be greater than the expense of constructing the breakwater in that space?—Yes, that adds to the to the necessary work which must be done at the pier-heads.

3741. Would it not expose the bay to the incursion of the sea?—No, because I stated that it would not require a wide entrance there for vessels to get out occasionally.

3742. How wide would you make it?—200 feet, or 250 feet.

3743. (*Chairman.*) If there was an entrance sufficient for vessels to go out at, do you then apprehend it would endanger the ships from the incursions of the sea?—No, I think not, because the surface in the mass of water, behind the breakwater, is so large compared with the opening, and knowing there is an entire opening, miles in extent, at the end, I do not think it would have an injurious effect on the vessels at anchor.

3744. Do you consider the attack of the worm an objection against the use of limestone?—It is an objection, no doubt, as far as it goes; but I think it a less objection to keep up the breakwater made with that stone, which is so much cheaper than it would be to make it with any other stone which the worm would not touch. I would feed the worm rather than buy a dearer stone. The Portland stone is so cheap that you could better afford to make two breakwaters in Portland Road in 500 years than bring stone from Guernsey to make it with.

3745. Suppose it to be desirable to improve Newhaven, are you prepared to give the Commissioners any plan as to the best mode of carrying it into execution, in order to increase the capability for receiving armed steamers, and for the more easy access of merchant-vessels seeking shelter there?—It is a very difficult subject that of Newhaven, and I have no satisfactory opinion in my own mind about it. I think that whatever be done there, with a view to a deep-water entrance, may never be wholly worth its cost; because, with very little or no expense, I suppose from four to six feet may be maintained at low water, and it will take very great expense to get more than 10 or 12 feet at low water, if you maintain it. It is a very long way, 500 yards, into two fathom water.

3746. Putting the expense out of the question, should you think it a desirable plan to adopt to lengthen out the piers so as to get into 12 feet water?—That is the most certain way of getting out into 12 feet water.

3747. Would you widen the entrance in carrying out the piers?—Yes, I should make it wider certainly than they are at present; I do not see why one of the piers, the eastward one for instance, might not be carried further from the other in approaching the shore, and the westward pier carried to the east, so that the set of the ebb-current would hug it close.

3748. Now, if you open it to any great extent, would it not diminish the force of the current of the egress water?—Supposing the eastward one is widened next the shore, I should make the other with a sweep. I believe it will keep as deep water close along side the curved pier as it would between the two straight and parallel ones.

3749. Where would you carry this to?—To the shore to protect all that difficult part of the coast.

3750. The moment the water escapes the narrow part of the channel, would it not expand and lose all its strength outwards?—No; it would not be empty. All this part would be filled with water, but the current would run close to the pier.

3751. Would it not, when it came past the eastern pier, have a tendency to expand and become more feeble in its duration?—No; if we take the bend of any river whatever, we always find deep water on the concave side.

3752. You would propose, then, a pier or groin reaching to the shore?—Yes; so that high water would not go over it.

3753. How in that case would you leave the present eastern groyne?—The present eastern pier might in that case come up. I think you might always maintain as deep water within side as you could get out, which is all you want.

3754. Are you aware of the great mass of shingle inside the eastern pier?—No; I am not aware of the accumulation of shingle there. I used to know a great deal of this harbour at one time, and the great difficulty we had was to keep the beach; and I think since I have known it the parties have put down the groynes to keep it there.

3755. I think you stated that, in the event of carrying out a pier or breakwater in the line you suggest, you would take away the eastern pier?—Yes.

3756. How far?—Up into the river.

3757. How far into the river would you take it away?—To the whole extent.

3758. Would you construct anything further back?—Make it a good river channel.

3759. Without constructing anything?—Yes, as this would be a comparatively narrow entrance, and no heavy sea could roll in at all.

3760. What breadth of entrance would you have?—Not more than 150 feet, or from that to 200 at the utmost.



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3761. Would you not give at once scope enough to meet all the risk of an awkward ship coming in yawing about?—Then you will not keep the shingle away from the mouth of it; you want the jet of the ebb-current to have as much effect as possible.

3762. Then the whole expense of your improvement would be simply the pier or groin, and the removal of the eastern wall?—It would be some 30,000*l.*, I suppose, or from that to 50,000*l.*

3763. Do you consider the removal of the eastern pier as an essential point?—I think if an eastern pier were put in direct from the shore, all the minor eastern works might be taken away.

3764. Would you recommend them to be taken away as an improvement to the harbour?—Yes, because there would be a better outlet for the current, but it must always be combined with the west pier curved to the eastern.

3765. (*Captain Washington.*) Why must it be curved?—It would not otherwise keep a uniform channel.

3766. Are you aware that the outset at Newhaven is very great at present?—Yes.

3767. Do you contemplate dredging the harbour to the same depth as the entrance?—I should dredge and improve the channel upwards to the bridge.

3768. (*Chairman.*) Do you recommend anything being done with Sleepers' Hole in order to procure a greater power of back water?—No; it would be throwing away money; that has silted up more than 10 feet to my knowledge.

3769. In how many years has it silted up 10 feet?—Perhaps 20 or 30.

3770. Do you think if it is lengthened out on the plan you propose, it would be desirable to try to obtain any greater rush of back-water?—The beat means to obtain a rush of back-water is to improve the channel of the river up to the town. I should improve the channel; I do not recollect exactly the form, but I have speculated some years ago of straightening the channel past the town. There is a bad bend by the town. If the harbour was ever improved at the mouth, I would straighten the channel from the mouth up to and past the town.

3771. Looking to the possibility of a breakwater being constructed in the front of Seaford or near Newhaven, and the possibility of requiring this harbour for large steamers, do you think it might be desirable to excavate by Mr. Catt's marsh-land for a basin?—I think it might; but if a harbour were enclosed off this coast, it would be a doubtful point whether the river ought to run into that. If the river was taken to the westward of it, it would make a good entrance into the harbour; and then the question is whether the new harbour would not silt up.

3772. Would you think that applicable to a simple breakwater?—Not to a simple breakwater with open ends. The best thing to do with Newhaven is to improve the channel to above the town, and to make an extended pier into two fathom water.

3773. Supposing a dredging-vessel to be employed merely with buckets to lift up the stuff, and passing round and round, would not that have the effect of clearing away without the great expense of loading and unloading barges?—Yes; that would be one means of tending to keep the thing clear of light silt.

3774. Of any description of stuff?—To do that you must make the whole of the water, during the whole of the ebb-tide, more turbid than when it entered on the flood, that is, make a little more mud go out every tide than came in; on the same principle that they keep water in boilers from getting too salt; and that would be trouble and expense.

3775. Of course this is an operation that would only go on in a falling tide?—Exactly so; but when we come to acres and hundreds of acres, it is a very difficult and expensive operation.

3776. (*Captain Washington.*) Would not Sleepers' Hole be space enough to form a basin, if required, for refitting steamers?—Yes, a very useful dock might be made in Sleepers' Hole for the purpose of re-fitting.

3777. (*Chairman.*) Have you any knowledge of Harwich Harbour?—Yes.

3778. Are you aware of the state of Harwich Harbour?—Yes, I am aware of its general state; that the one side is going away, and that the other is going also; thus making both sides shoal, and spoiling the entrance by contrary operations.

3779. Are you aware of the great lengthening out of Landguard Point?—Yes.

3780. To what do you attribute the elongation of the point so rapidly?—First, from the extension of that part of the coast to the southward; and, next, the working away of the opposite shore; and thus widening the mouth, if I may so term it, of the entrance.

3781. What is the cause?—The prevalent winds and the flood-tide both act in that direction.

3782. Are you aware of a considerable shoal off Felixstow having been removed?—I do not know the special case, but I know all the cement-stones on that coast have been attacked by cement-makers.

3783. Do you think groins would be desirable run out on this shore?—No, I do not think that would do so much good as doing something like what is shown in pencil on this plan.

3784. What would you recommend to be done to improve the entrance to the harbour?—Put out a pier on the Harwich side from Beacon Cliff to Cliff-foot Rocks.

3785. Would you have a breakwater to shelter the foot of the cliff?—I would have the Beacon Cliff form the inner end of the breakwater—to groyne from it, as it were.

3786. And that is the direction you would give it?—Yes.

3787. Do you think that breakwater would cause the tide to act on Landguard Point, so as to increase the beach?—It would have a tendency to do it.

3788. Does it not, according to the line given now, go too much without it?—I do not think it does; it is all shoal water below the point. I think a few yards more or less either way



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would have nothing on the general effect; the general way would be to make the best channel into the harbour. The points I have mentioned appear from the chart to be the best, that is, that they terminate in rock, because if turned further into the harbour it would not have the Cliff Rocks to end on.

3789. (*Lt.-Col. Colquhoun.*) How far did Landguard Point extend out when you first knew it?—Close round the Fort.

3790. How many years ago?—About 40 years ago I first knew it.

3791. How near the top of the glacis?—That I cannot precisely charge my memory with; but I think it was less than 100 yards.

3792. Is there anything else you would suggest for the improvement of this harbour?—Remove all shoals and put up a good breakwater; a good deal might be done internally.

3793. You would remove shoals in the way of free passage?—That is the first and great concern, I think.

3794. Are you aware that down at the Lower Lighthouse terminates a very solid wall of the Ordnance, and that it was suggested to make the breakwater abut there, and come off in such a direction as to be a continuance of that sea-wall?—I did not know the object of it, but I prefer the extension of Beacon Cliff to Cliff Rock, in preference to the long curve from the lighthouse.

3795. (*Captain Washington.*) Do you consider these measures essentially necessary for the preservation of Harwich Harbour?—I think something is essentially necessary for the preservation of Harwich Harbour.

3796. And what you have stated you consider to be the best?—Yes, I do; a straight pier from the Beacon Cliff.

3797. Do you recommend a general dredging of the channel?—Yes.

3798. Are you at all aware of the expense of dredging the shoals?—I am aware of the expense of dredging generally; the shoals I take to be clay; I should say the expense would be 1s. a cubic yard.

3799. (*Chairman.*) In the Report of the Harbour Commission of 1840, of which you were a member, a decided preference is expressed in favour of Dover for the construction of a harbour; are you still of opinion that for the convenience of the trade, and as a station for armed vessels of war, it is the best position along the south-east coast?—I am decidedly of opinion that, taking all circumstances into consideration, Dover is the most proper place for such a harbour; and I am also of opinion that a harbour may be so constructed in Dover Bay as to obtain all the advantages of which the situation is capable, without letting in any of the evils to which it is more particularly liable.

[ *The Witness withdrew.* ]

Wednesday, 19th June, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Jesse Hartley, Esq.

Jesse Hartley, Esq., examined.

3800. (*Chairman.*) In what situation are you employed?—I am the engineer to the Liverpool Docks.

3801. Have you ever been engaged in the construction of breakwaters?—Never.

3802. Have you constructed piers or sea-walls in exposed situations?—Yes; I have had experience in the construction of such works.

3803. Suppose it to be decided to convert Dover Bay, Dungeness, or any other place into a harbour, with a sea front in seven fathoms at low water, having regard to economy and speedy execution, so far as the same may be consistent with the solidity and permanence of the work, will you give to the Commissioners your opinion as to the mode and the materials for constructing such a work?—I do not feel that I could do so without having some knowledge of the situation and the neighbourhood in which such a work was to be placed; a great deal depends upon the locality in obtaining the materials, a very small material may be made to answer the purpose very well, where larger materials cannot be obtained, and perhaps would come cheaper than larger ones.

3804. Do you know the locality of Dover or Dungeness?—Not particularly; I have been there.

3805. You do not know the localities sufficiently to give an opinion upon them?—No.

3806. Considerable doubts being entertained as to the slopes, and particularly the sea-slopes of breakwater the least likely to be damaged by the action of the waves, you are requested, on reading Colonel Jones's paper on this important subject, to give us your opinion?—I have read his paper, and it perfectly coincides with my own ideas generally upon the subject, the principle I perfectly agree with.

3807. Will you state what the principle is?—To make a stronger and more efficient work by the present mode of construction than is at present used. I go all the lengths, and perhaps a little farther than Colonel Jones does.

3808. What do you mean by going a little farther?—I would have a greater quantity of upright wall.

3809. From the base?—Yes; I would make the base considerably broader; nature forms lines in all material that is thrown into the sea according to the nature of the ebb,



and the quantity of wind it forms, a natural section which it is always necessary to follow. I think that particularly as to the bottom part, but even as to the upper part, the more perpendicular it is the better it would stand.

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3809. Between low and high-water mark?—I would go below the surface of low-water mark ; considerably lower—as far as I could get.

3810. By what process would you construct such a work by caissons?—That entirely depends on the material which you have to use ; if you get very large blocks of stone, such as we get near Liverpool, you can lower them down easily ; in other cases, where you have a small material (which perhaps if you get the right kind of material is better even than large stones), you would sink them in caissons.

3811. What is the largest stones which you use?—We can get them of any size.

3812. Practically speaking, what is the largest size?—About 10 or 12 tons.

3813. Of what description of stone?—Sandstone.

3814. In using chalk, which is a material that abounds on the coast of this part of the country, would you use caissons?—In such a case I would use caissons.

3815. In constructing caissons, would you make use of wood or iron?—Iron would be preferable, if you could meet the expense.

3816. What do you imagine would be the difference of expense between wood and iron in a length of 100 feet?—I do not suppose there would be much difference.

3817. The iron would have greater durability?—If the thing was properly constructed, the iron in its decay would create a durability in the material.

3818. You would prefer iron for the caisson, except on the point of expense, in which you say, however, that you do not think there would be much difference?—Yes ; I should not make caissons ; I should make large chests or boxes which should be lowered into their places.

3819. Of what description would you make them?—Much would depend on the material ; perhaps they might be 20 feet long and 10 feet wide ; the dimensions, of course, must vary according to circumstances ; you might make the chest of any dimensions ; you might have them as heavy as you could lift, with two floats, and lower them into their place exactly.

3820. Would not boxes of that size be very apt to be moved by the action of the sea?—I think not, if they were properly managed ; it depends upon how the work is carried on.

3821. The weight of a box of that kind does not seem sufficient to keep it in its place?—The weight of a box of that kind would be 50 or 60 tons.

3822. Would it be 60 tons without the iron?—The dimensions must all vary according to circumstances ; some would be wanted large and some small, they would vary very much ; a great deal would depend upon the nature of the bottom.

3823. Are you sufficiently acquainted with the south-east coast, and sufficiently in the habit of forming or examining breakwaters to give an opinion to the Commissioners as to the best form for them?—I never yet have seen a breakwater which I thought was built as it ought to be.

3824. Will you have the goodness to state what you believe would be the preferable form for constructing them?—Without being on the place for some time, I could not give an opinion on that. I consider that a breakwater should be so constructed as to keep itself free from accumulation.

3825. You mean that no accumulation should take place inside?—No ; I consider that a breakwater should be so constructed that ships might enter and leave it at all times, and that there might be a self-acting scour or current through it.

3826. By keeping a wide opening at each end, and merely having a breakwater in front, would not a considerable sea come in at each end in most situations?—Yes ; a great deal depends upon the locality of course.

3827. Your object in having it in that way is to prevent accumulation ; to give the tide a fair run through?—Yes ; a fair run through.

3828. You are understood to object to all harbours that you have hitherto seen?—I have not seen one that I thought was what it ought to be.

3829. Have you seen the Plymouth breakwater?—I have.

3830. Do you approve of that?—It is many years since I saw it ; I do approve of it as a breakwater, because it can be approached at any time ; but it appears not to keep itself free.

3831. You approve of its position, but not of its profile?—It is a sort of thing that I should prefer to an enclosed structure. In 1824, I think the plans of General Bernard for a breakwater in the Delaware were sent to me for my opinion. I objected to the plan, and gave the parties my reason for the objection ; but they only carried it partially into effect ; and in consequence of their not carrying it fully into effect, it is now silting up.

3832. What was that plan?—It was a straight breakwater, with two others at a distance from it to break off the ice, but still to maintain the current.

3833. In what depth of water was it?—I think about 22 feet at low water ?

3834. At the front of it?—Yes ; the slopes were very much like the Cherbourg breakwater ; I see that Colonel Jones states that they are upright, but they are not so ; they are pretty much the Cherbourg slopes.

3835. You have described the Delaware breakwater as consisting in fact of three breakwaters?—Yes ; the Delaware breakwater, which I recommended, was three breakwaters, a front breakwater and two others. One was placed longitudinally and the others across the end of it.

3836. The breakwaters do not join to the shore?—No.



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3837. Will you describe what was the alteration which you suggested in the Delaware breakwater?—Mine was an alteration of General Bernard's plan; I objected to it on account of the elbows at each end.

3838. Those elbows were not at the front of it?—No.

3839. If you were called upon to construct a breakwater, the Commissioners gather from your evidence that you would have it in front only?—Yes.

3840. Without anything running off at the sides?—It would depend upon the situation; it might want some cover at each end, a short breakwater, perhaps, to prevent the sea rolling in, but that depends entirely upon the site of it.

3841. Supposing your pier-head runs out into seven fathoms water, and shingle is brought into that depth of water, will it be swept away or will it remain?—I am afraid, in that depth of water, it would remain.

3842. Do you consider that an old man-of-war, built in with stone is good as a caisson to form a breakwater?—You might make them as good, I think; but taking them in their present state, they are not so, because of the bilges; they would not stand upright; I think, however, that you could not have a better thing than something of that kind.

3843. When the ship decayed, would it not fall over?—You could not make the masonry so close; you might put the masonry inside, but whenever the wood decayed, the openings that would be left would create a great deal of cavity that would be very objectionable. In iron caissons they would come so close together that there would be no cavity.

3844. Would not that also be the case with wooden caissons of the same form?—They are never made tight to the masonry.

3845. When you speak of upright faces, do you mean a vertical structure, standing upon a foundation previously laid, having a slope outwards, or in every case a vertical wall built upwards from the bottom?—I would build the vertical wall upwards from considerably below low-water mark; I should prefer it nearly upright, but rather inclining outwards; I would have it overhang a little towards the top, above high-water.

3846. What is the foundation, and how do you propose to form it upon which you would erect that superstructure?—I would have caissons of iron and timber, and lower them down.

3847. How would you proceed as to the foundation?—I would have each caisson adapted to the bottom.

3848. Moulded to the bottom?—Yes.

3849. How would you lower the caissons?—By means of two lighters.

3850. You have said that large masses of stone might be used instead of caissons if that material were abundant?—Yes; only with caissons you can cover a larger space. Those stones are very difficult to get; but you may build caissons on the shore, and bring the materials there.

3851. Where you have the materials on the spot you think that large masses of stone might be used?—They might be, but I am doubtful whether the other plan would not be a more speedy and economical method, if you can get the right kind of mortar.

3852. At what rate do you suppose the profile required at Dover would be constructed?—I do not know.

3853. Allowing every limit as to expense, what would be the condition in point of time; how many months or years do you think would be necessary to construct a mile?—I should say it might be done in about four or five years if there was no limit in point of expense.

3854. In seven or eight fathoms of water?—Yes.

3855. While one portion was going on, other portions could be proceeded with likewise?—It might go on in many places at the same time.

3856. Have you any notion what the cost of a mile would be?—I have no idea of it; it would take a great deal of consideration before such an estimate could be arrived at. I think it very likely that the small granite would be as convenient as anything; that might be thrown out from the vessel into the caisson without going on shore.

3857. Do you know anything of the effect of the worm on stone?—I know a great deal too much of it.

3858. Whereabouts have you had experience of it?—At Liverpool it is a great nuisance.

3859. In what description of stone?—It is not in the stone, the worm has not attacked our stone.

3860. It does not touch the sandstone?—No, it will only take the limestone.

3861. Does Portland stone partake of that quality?—Anything that has got lime in it the worm will touch, but nothing else.

3862. That must depend upon the locality, because there are some places where there are no worms at all?—I was told, some years ago, that at Sheerness a 12 inches square pile of Baltic timber was eaten through in 12 months; but the harbour-master at Dover wrote me, about 20 years ago, that they did not know what the worm was there.

3863. Wherever there is blue clay the worm is more destructive than anywhere else?—Yes, we have none with us; the greenheart timber they will not touch; we have pickled our wood with arsenic and all sorts of things.

3864. Have you tried any of the African oak?—Yes; they will eat that.

3865. And the teak wood?—Yes; they will eat that.

3866. Did you say that at Dover there was no worm?—There was not at that time, 20 years ago.

3867. Would you propose the employment of limestone in any construction under water at Dover?—Not in the front.



3868. (*Lt.-Col. Alderson.*) You would case it with granite?—Yes, either with granite or basalt. *Jesse Hartley, Esq.*

3869. Could you form any sort of calculation as to the price of the caissons?—I could form a calculation and transmit it to the Commissioners. 19th June, 1844.

3870. Have you had much experience in the use of the diving-bell?—Yes.

3871. In building?—Yes, a good deal.

3872. Do you think that the foundations of the wall below low-water could be constructed better by means of the diving-bell than by lowering the stones and letting them find their level?—Yes, but it is more expensive.

3873. Do you speak generally of any depth of water?—Yes; I think I would sooner trust to boxes, without any diving-bell.

3874. At what depth of water are you speaking of?—Seven fathoms.

3875. Do you use a dredging-vessel much at Liverpool?—Yes.

3876. Do you load barges from that vessel, or do you merely keep it in motion to carry off the mud?—We load barges.

3877. What do you do with the contents of the barges?—We throw it into the tide.

3878. (*Chairman.*) Suppose on an ebb-tide, without loading barges, you kept whisking it up and throwing it out into the water, would the mud be carried out by the ebb-tide?—If the tide was sufficiently strong it would go away.

3879. Are you acquainted with Portland Roads?—I never examined the situation of Portland. I have passed it.

3880. Do you know Newhaven?—I am not much acquainted with any of that coast.

3881. Will you look at the plan before you; supposing a breakwater ran out in the direction described in that plan, do you think any opening in such a breakwater desirable or not?—I could not give a satisfactory answer to that question.

3882. Are you of opinion that a close harbour like that which is traced in this plan in Dover Bay would silt up very soon?—I should have a great objection to all close harbours anywhere; they all silt up very fast.

3883. That is not the case at Kingstown, is it?—It is the case with all that I have seen. I should qualify my answer perhaps to this extent, that it depends to a certain degree upon the nature of the coast; if there is much sand or shingle, it is almost certain to fill up; where there is no sand to come in, it may do very well.

3884. Are you acquainted with Kingstown harbour?—I have been in it twice.

3885. Are you aware that that harbour does not silt up at all?—I am not aware of it; but there is no sand on that coast; it is all hard rock.

3886. Will you name any harbour which you have known silt up?—I cannot at the moment call them to mind. Whitehaven, for instance, does.

3887. Into which a stream runs?—I believe so.

3888. Bringing down a great deal of detritus from the land?—Yes; the basins at Liverpool, outside the dock gates, silt up very much also.

3889. Do the basins at Liverpool silt up from matter held in suspension brought down by the river, or brought in from the sea?—It is not brought in from the sea, it is all brought in by the river.

3890. Do not you think that to be generally the case?—It is generally the case.

3891. In all harbours that silt up?—Yes.

3892. Are there not a great many ships lying in the basins at Liverpool from which things are thrown overboard?—There is nothing permitted to be thrown overboard; we keep too close a watch upon them for that. We had a dock run dry the other day, which had not been run dry for ten years, and I was much surprised to find it so clean, there was nothing at all in it, there was very little silt and no rubbish.

3893. Had the sea-water any access to it?—Yes.

3894. (*Lt.-Col. Alderson.*) As you know Dover, and the quantity of sea which there is in Dover Bay, do you think that the diving-bell might be depended upon as a means of executing any large quantity of work?—I think it would never be done by a diving-bell in a place like Dover Bay.

3895. From the quantity of sea?—Yes.

3896. What do you think of large masses of brickwork built and carried out and sunk for a breakwater?—If you put brickwork together, of very hard-burnt bricks, you could have nothing better.

3897. (*Lt.-Col. Colquhoun.*) Specific gravity is a great element of rest, is it not?—Certainly, basalt would be better than granite.

3898. Do you know any instance of concrete having stood under water?—I should have no fear but the concrete made of Dover gravel, with our mortar from the Halkin mountain lime, would stand for any length of time under water.

3899. Do you think that the artificial foundation which you propose, that is to say, caissons, whether of iron or timber, filled in with concrete, would bear the enormous weight of that structure of upright breakwater, and permanently resist the crushing effect that would be produced?—Yes, I think so, if properly constructed.

3900. Notwithstanding what you have said with respect to the good quality of hard-burnt bricks laid in good mortar, would you recommend a brick face to be exposed to the action of the sea?—No.

3901. Your observation with regard to bricks would apply to the backing only?—Bricks burnt on purpose I should have no objection to use towards the sea, but not a very small brick; I would have a very large one used.

[*The Witness withdrew.*]



*J. M. Rendel, Esq.*

*James Meadows Rendel, Esq., examined.*

19th June, 1844.

3902. (*Chairman.*) Have you been engaged in constructing breakwaters?—I have.

3903. In what place?—At Plymouth, Mill Bay Pier, just finishing in the Port of Plymouth, and on different parts of the coast.

3904. Into what depth of water does that pier at Mill Bay go.—Forty-eight feet at low water.

3905. Suppose it to be decided to convert Dover Bay, Dungeness, or any other place into a harbour with a sea front in seven fathoms at low water, having regard to economy and speedy execution, so far as the same may be consistent with the solidity and permanence of the work, will you give the Commission your opinion as to the mode and materials for constructing such a work?—To construct a breakwater in seven fathoms water is, I apprehend, a very formidable undertaking, especially if any of the ingenious contrivances of caissons and machines of that kind are to be resorted to. I doubt very much, if a breakwater is to be constructed in seven fathoms water, whether the only safe plan would not be to deposit in the usual way from vessels, if it is a detached breakwater, or from a railway, if it is a breakwater connected with the shore, and the shore produces suitable materials, a mass of stone up to within, say, two or three feet of low-water; and above that to construct perpendicular walls of the kind referred to in Colonel Jones's letter of suggestions. I do not know of any instance where a breakwater of the magnitude now contemplated has been constructed, and I do not think that a breakwater of that magnitude should be attempted by caissons, until the plan had been found to answer on a smaller scale. With reference to the particular localities referred to, not having made personal examination of them, I should not be prepared to give the Commissioners that decided opinion by which I should wish them to be at all influenced. It must be manifest to every member of the Commission, that in treating a subject of this sort, the nature of the locality of the materials to be used, and all the circumstances of the case should be known to the engineer, and he should have an opportunity of balancing those circumstances, and drawing out, as it were, a debtor and creditor account in such a manner as to enable him to arrive at a right conclusion.

3906. You spoke of ingenious contrivances of late, what do you particularly allude to?—I mean those systems of building breakwaters in very deep water in caissons, which have lately been proposed by different engineers. I would first refer to that proposed by Mr. Cubitt for Dover, and then to that proposed by Mr. Bremner; those are very ingenious contrivances, and they would answer on a small scale, but I do not see how caissons of a magnitude suitable for seven fathoms of water are to be made, filled, floated, and sunk. I think it is a very formidable undertaking to attempt. I have myself had a good deal of experience in building in caissons. I have founded a bridge by caissons; those were only 60 feet long and 25 feet wide, and though they formed (having reference to the difficulties) the best mode that we could adopt for making the foundations, still I know, from the trouble we had with them, that they are very formidable machines of that magnitude only, in a rapid tide-way.

3907. In what depth of water were those?—They were sunk in eight feet of water at low-water spring-tides, and we had 19 feet rise of tide. I should say therefore, as to building a breakwater with caissons, I should like to see such plan first attempted on a much smaller scale than in seven fathoms of water.

3908. On what scale should you suggest?—That would depend upon the degree of exposure of the situation. If it were in a very exposed situation, I should not certainly like to be responsible for an attempt beyond three fathoms of water; I think three fathoms of water is quite a sufficient depth for the use of caissons in an open roadstead, on an exposed coast.

3909. Having deposited them in three fathoms water, and found it answer, you would be tempted to go on?—Yes, if I found that, under all circumstances, it was the most economical mode of forming a breakwater; but I take for granted the object of adopting one plan in preference to another is, to obtain a successful result with the least cost, and I think therefore that every situation must be dealt with in reference to its own peculiarities, and the skill of the engineer is as much called out in adopting a right system of execution as in making a right design for the situation.

3910. You are understood to say, without reference to particular localities—confining the question to the depth of water anywhere—that if you found, after the sinking of your caissons in three fathoms, that they answered successfully, you would be encouraged to go to a greater depth—that you would have made a sufficient test to lead you gradually on?—I think if I succeeded in sinking the caissons in three fathoms water in a way to obtain a successful result with reference to the permanence of the work so constructed, and to its cost, I should be tempted to take another step, and go another fathom; and if still successful, I would take another step, and go another fathom; but as a practical engineer, knowing the difficulty of attempting anything new on such very large scales, I should not be disposed to calculate upon forming a breakwater in any of the localities named in seven fathoms water by means of caissons.

3911. Have you used caissons in any other places than where you have just mentioned?—No.

3912. How long ago is that?—It is about 17 years ago.

3913. Are you aware of their present condition?—I believe they are perfectly secure; but the bed of the river in that case being entirely quicksand, the foundations had been previously prepared and enclosed by piles, and then the masonry was built in the caissons,



which were used because we could not exhaust the foundation of water. It was impracticable; no coffer-dam we could have placed there would have answered, and we were obliged to resort to the caissons as the means of laying these foundations, or to the diving-bell; and on full consideration, I found that it was cheaper to adopt caissons; though afterwards, to expedite the work, we resorted to the bell also. The result of the experience I had with these caissons would make me seriously hesitate before I should undertake a formidable breakwater, in an exposed situation, in more than from two to three fathoms water in caissons as a first step.

3914. Would you prefer wood or iron in caissons?—Most decidedly wood.

3915. Would you cover them with scupper-nails?—I can only consider caissons applicable at all as the means of beginning the work or forming a nucleus for the breakwater; I hardly imagine they would be used where the material of the caisson was afterwards to form a part of the breakwater, I should therefore look at the caissons as the means of getting a nucleus about which I was afterwards to make my permanent work.

3916. Have you described the nature of the slope you would give to a breakwater?—I have not.

3917. Considerable doubt being entertained as to the slopes, and particularly the sea-slope of a breakwater, as least likely to be damaged by the action of the waves, you are requested to state, on reading Colonel Jones's paper upon this important subject, your opinion upon it?—I think Colonel Jones would be very likely to fall into the same error in universally applying perpendicularly-sided breakwaters as other engineers have been of universally employing sloping ones. In all these cases there must be a distinction, that distinction being drawn from particular circumstances; the nature of the material, the nature of the site, and all the local circumstances of the case which an engineer has to deal with; and I can no more imagine the universal application of perpendicular-sided breakwaters than the universal application of sloping ones; and he who would adopt either as his practice without any variation, would be very much like a person who thought one medicine suitable for every disease. I cannot imagine that you can lay down a rule that should invariably be adopted either for perpendicular or sloping-sided breakwaters. I believe, in most cases, a benefit will be found to result from the combination of the two; I think therefore that Colonel Jones is right in the principle he has adopted or recommended in this sketch, which is tinted red. It is all very pretty to show these stones here in the nice order of adjustment a draughtsman can draw them. I know from experience it is quite impossible so to execute it. You could not put in those stones with a diving-bell, at that slope; the slope must be flatter to get them in with a bell; and I know of no means by which you could get slopes of that kind paved as here shown. I do not think the breakwater is at all strengthened by having the stones adjusted by hand in the way here represented. I think if the stones were thrown in and allowed to form their own slope, that slope being determined by the nature of the materials up to within two or three feet of low-water, and then the breakwater raised upon that with perpendicular sides, it would be the most economical plan in most situations. But there should be a very considerable benching between the point at which the slope terminated and that at which the perpendicular breakwater began, otherwise the chances are that the perpendicular wall would be thrown down by the disturbance that always takes place in a work of this kind at the angular point.

3918. You are acquainted with the Plymouth breakwater?—Intimately.

3919. Do you approve of that structure?—I do not. I think the Plymouth breakwater has been a misconception, both as to the exclusion of small materials and as to the enormous magnitude of the mass of materials. I think the slope has been altogether more than was necessary; if a plan on the principle of Colonel Jones's had been carried out, I think there is a larger mass of materials than would have been then required, and you would have had the same result at a smaller cost. But I think, at present, all the ends that could be desired for the breakwater, as a fortification and a shelter for Plymouth Sound, would be accomplished by raising a parapet upon the present work, and preventing the sea from rolling over it in the way it now does, which is one of the causes of injury it so frequently sustains. The slope forms an inclined plane, up which the sea is able to roll the large blocks of stone which form what is called the fore-shore, and to throw them on the land side. This, I believe, is now pretty generally admitted. I would say, as to the Plymouth breakwater, that it is weak in comparison with what it would have been if the small materials that were rejected in the formation of it had been carried out and deposited with the large; and I speak with some confidence from the fact that I have had an opportunity of ascertaining the degree of solidity of that work; and I know that, even in its present subsided state, it is not solid by more than 32 per cent., that is, out of every 100 feet of mass 32 would be vacuities.

3920. With that feeling, do you entertain any doubt as to the security of the lighthouse at the end?—No, because I think the foundation of that part of the work has had a long time to subside, and I think there also they have lately used, and indeed for many years past, small materials. But such is the fact generally; and you may easily ascertain it by taking sections of the work as it exists, and dividing the cubic contents, computed from those sections by the whole quantity of stone carried out. Now we all know that 13 cubic feet of the material of which it is built is a ton, therefore if you find that every ton carried out has filled 22 or 23 feet of space, you have, of course, the proportion of interstices. In the pier that is building in Mill Bay, by adopting a different plan, we have a different result. By carrying out the materials as they are quarried, large and small together, and depositing them at the same time, with the very same materials we have, if we take the whole cubic contents, and divide that by the number of

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tons, 17 is the result, which shows that the solidity of the work is as 17 to 13; and I need no say that solidity is a very important matter in determining the strength of the work.

3921. In Mill Bay you have shallow water, would you recommend the same plan of proceeding in deep water which you are now following there?—We have 48 feet water in the last 100 feet of Mill Bay Pier at low-water.

3922. (*Admiral Dundas.*) Suppose you are hurried to make a breakwater, in forming the nucleus of the breakwater in seven fathoms water, would it be economical to sink old ships filled with stone well cemented together, and then proceed to finish it by a perpendicular wall above?—In carrying out any great breakwater of the kind referred to, I do not look at any of those unusual or extraordinary means as promoting economy or saving time. I believe the only way in which you can construct breakwaters of the magnitude we are speaking of, is to go about it with all the appliances which modern science and experience would give, not resorting to either caissons or old ships. I do not believe that it is likely to lead to an economical or a profitable result. I believe the only plan would be to adopt the readiest and the most obvious mode; and in fact those plans which the experience of modern days and modern science point out. I do not think that the plan of sinking caissons or old ships is the best.

3923. Do you consider, that in constructing a breakwater by means of old ships, danger would arise owing to the formation of the bottom, when the old ships were destroyed?—I think that that is one objection among many others.

3924. When the caisson or the old ships were destroyed, would the formation of the breakwater inside be safe?—I think not; but I would go further and say, we are now contemplating breakwaters in seven fathoms of water, I think the chances are, that the vessels would burst, and the materials would be dispersed to some degree, particularly if they had a superincumbent weight. But whether they would or not, I cannot imagine that sinking old ships loaded with stone is an economical way of constructing a breakwater.

3925. Looking to the construction of the breakwater inside the ship, after the ship was destroyed, would the breakwater be safe?—The only reason for sinking old ships would be, that it would be an economical way of constructing a rubble breakwater; therefore, if it were decided on, I take for granted the bursting of those vessels would only allow the subsidence of the materials to an extent that would not materially interfere with the permanence of the work; but I cannot imagine a breakwater built in seven fathoms water by any of those expedients.

3926. A ship would not be an economical sort of caisson?—It is a species of caisson, and if the caisson should be decided on as practicable, I think a cheaper, and better, and more efficient kind would be found in one built for the express purpose.

3927. (*Chairman.*) In your works at Mill Bay have you sustained any inconvenience from the action of the worm?—Not the slightest. There are worms and shell-fish that act chemically upon the limestone; but I should as soon object to a coast of limestone rock as an inefficient barrier against the sea as a breakwater built of limestone, the mass is so great.

3928. Have you not sustained any injury?—Not the slightest. In Plymouth Breakwater you may find stones that are holed.

3929. Is not the mischief done very general in the Plymouth Breakwater?—You may see a great deal in walking along the slopes of the Plymouth Breakwater, but I apprehend that it is not a practical objection.

3930. You do not think it is an objection against the use of limestone?—No; I should not, as a practical man, object to it, where the mass is so great.

3931. What is the estimate per yard of the present breakwater in Mill Bay?—We do it very cheaply indeed; we have the materials close at hand, and run them out on temporary stages, and the material is dropped through the bottom of the waggon directly into the work. It is costing us an extraordinary small sum. The whole pier, which is about 500 feet long, will not cost more than 33,000/. I should say per cubic yard, the materials, including what the stone would sell for, certainly not exceeding 2s. 3d. a-yard in the work; I mean that if you measured the cubic contents of the work, the materials in the work would not cost more than 2s. 3d. a-yard cube. Of course that has nothing to do with the facing of the pier.

3932. Take a yard of breakwater from the bottom up to the top?—That I cannot tell, without going into a calculation.

3933. Will you have the goodness to look at the plan before you of Dover Bay; are you of opinion that the sketches now before you present a good plan for a breakwater, with any modification you may recommend in them?—I have very great hesitation in approving or disapproving of either of those sketches without having made personal examination. I have no doubt those who made the plans have taken the precaution of doing so, and that they are competent to the task. I am perfectly satisfied of this, that a large area should in all cases be preferred; and the larger such area the more likely you are to have a successful result.

3934. That is, you would have less liability to silt up?—Suppose the opening to be the same, manifestly so. I think in all these cases we have committed a great error, from being afraid of making our works too large.

3935. Would you recommend a close harbour, or merely a breakwater?—That again would depend upon the size that I was permitted to make it. If compelled to make a very small harbour, by which I mean anything under 150 acres, I should be disposed to make it as open as possible. If I were permitted to make it 300 or 400 acres, it would be different.

3936. Take 600 acres?—I should make it as close as possible.



3937. Should you apprehend any great silting up in a harbour of that magnitude?—Not with a reasonably large entrance. Of course the entrance to a large harbour need not be larger than the entrance to a small one; and I believe that the silting up of a harbour of this kind, where there is no back-water to affect it, will be in a very considerable degree greater where you have a large opening, compared with the size of the harbour, than the contrary. I think the silting up will be much determined by the size of the opening, all other circumstances being the same.

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3938. Are you for or against a large opening?—I am for a large opening, as regards the use of the harbour, but for a small one as regards the silting up; and therefore, inasmuch as the opening should be the same, whatever is the size of the harbour, I think a large harbour should be preferred to a small one.

3939. What do you think a sufficient opening for ships coming in?—I do not think the opening for such a harbour as this in the largest plan before me ought to be less than 500 feet.

3940. Would you have an entrance at each end in such a harbour?—That would certainly add to the convenience of the harbour for shipping; but I doubt very much whether it would not injure the harbour in an engineering view; if you had two entrances you would be much more likely to silt up with a close harbour: if you had a detached breakwater, and your object was a shelter from prevailing winds, I should put the breakwater in the line of the currents as nearly as possible, and leave the harbour as exposed to those currents as I could, consistently with sheltering the roadstead. But if you have a close harbour, I should say, for all engineering purposes, that one entrance was better than two; for the convenience of shipping two entrances may be better than one in many situations.

3941. If either of these places were adopted, showing a line coming out from Cheesman's Head, should you have an apprehension of the shingle getting into the harbour?—Not if it came out into the depth here stated.

3942. If it came out into the depth of seven fathom, should you have any apprehension?—Not the slightest in the world; I do not believe that the shingle travels at anything like that depth.

3943. On the score of economy, should you prefer one or two entrances to a harbour of that sort?—On the score of economy, I should prefer one; the forming the head of a breakwater of that kind is a considerable work. The two heads would be about five times the cost of the length of the opening; it is a very formidable thing to make a head to piers of this kind.

3944. If you constructed a breakwater at Dover, if I understand you rightly you would do it by the deposit of stone, you would not do it by caissons?—There must be something more in favour of caissons than I am aware of—something in the locality much better adopted to their use than I know of to induce me to use them as the preferable mode.

3945. What should you think desirable in the locality to induce you to use caissons?—I should certainly require some very extraordinary conveniences for the appliance of caissons, and I do not think that they exist at Dover; suppose I could find in the immediate neighbourhood a sheltered place where I could build my caissons, and where I had stone that I could put into them, and where I had every convenience that would make them applicable both on account of economy as well as local circumstances, I should use them; but I do not know of anything of the kind existing in the neighbourhood of Dover. As to the use of chalk in the caisson, I do not think that an engineer would take upon himself the responsibility of sinking caissons filled with chalk in seven fathoms water.

3946. What would be the objection to chalk?—In the first place it would be liable to burst the caisson, the chalk would be dispersed, and you would be ruining the harbour instead of improving it; and if it is merely to form a nucleus, I think it is a very expensive way of obtaining that end; and I think that the difficulties are increased immensely by the proposition to build in seven fathoms water. I must repeat that you incur a great deal of risk in attempting a caisson in more than three fathoms water. All the timbers would have to be scarified for I cannot imagine any caisson to be profitable that would not bring you above low-water; and if you are to be brought above low-water in anything more than three fathoms water, it is a very formidable machine.

3947. The made caisson would be far more useless than an old ship?—I think a caisson would very soon become in effect an old ship if sunk: I doubt very much if a caisson sunk in six or seven fathoms water would not very soon become a wreck, which I take for granted an old ship is before you sink her.

3948. How would you recommend a breakwater to be formed in seven fathoms water?—I should be more disposed, if I had to build one in seven fathoms water, to adopt the plan I before referred to: suppose I had an unlimited command of materials, I should first of all begin to deposit those materials to form a rough mass up to within a moderate depth at low-water, and then when I had brought my foundations up to that point at which the sea would begin to attack me, I should begin to attack the sea by building with a class of materials that would be its master.

3949. In the shape of an upright wall?—I think an upright wall in that case might be desirable.

3950. A class of materials meaning what?—Certainly stone or vitrified brick, for the face work, built in large masses with cement, and carried out and put in position; and I am inclined to believe that brick-work of this kind might be adopted with great advantage in situations where stone would be too expensive. The interior of the blocks might be formed of the common brick of the locality, and the work could be built either by the diving-bell or by the ordinary setting machinery.

3951. (*Lt.-Col. Colquhoun.*) You stated, in reference to the breakwater at Dover, that you



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have no fear of shingle in seven fathom water, are you aware of such a formation going on in deep water for many years past at Dungeness Point?—I am not aware that in that case you get any shingle to a greater depth than perhaps very little below low-water.

3952. For the last 50 years the point has been protruded outwards five feet 20-hundreths every year?—I think it is an excellent opportunity which you have now of ascertaining all those facts; I do not know a case where the shingle exists in any mass below the level of low-water, or where it has travelled round a point projecting into two fathoms at low-water.

3953. Is not it travelling round Dungeness Point?—I should like that to be thoroughly ascertained; my attention was first called to the travelling of shingle in a case on the coast of Cornwall; I was called upon to design a harbour in Mounts Bay, between two headlands, or rather two points of rock, which protruded out into about two fathoms of water at low-water. On either side of these points are other bays. The shingle of this central bay is entirely composed of the debris of quartz rock. It is nothing more nor less than small pieces of quartz that in the process of time have become rounded by rolling to and fro (as the southerly or westerly or easterly winds prevail) over those two or three miles of shore. When westerly winds prevail, this shingle accumulates at the eastern headland; when the easterly winds prevail it travels back again and accumulates at the western headland. On the other side of those headlands you have quite a different kind of shingle. If the shingle travelled round either of those headlands, it would be detected from its being of a totally different kind to that which forms the shore east and west.

3954. What is the depth of water at the point?—I do not think it is quite two fathoms of water. You have the same kind of shingle point as at Dungeness; at the Kicker in Stokes Bay, near Portsmouth Harbour, which is growing up in the same way.

3955. Do you conceive that the accumulation of shingle is due to the wearing away of the cliffs, or is it thrown up from the bottom of the sea?—My conviction is that it is due entirely to the falling of the cliffs from time to time, I cannot imagine the sea acting upon its bed in deep water in a way to break up the solid chalk. Wherever my attention has been called to the coast, I never found the shingle much below low-water. I have never known it in one instance below low-water mark.

3956. (*Mr. Walker.*) Do you or not know that since I have had the direction of Plymouth Breakwater I have made it a point, both in my Report to the Admiralty and also my orders at the breakwater, that the interstices of the large stones should be filled up with small materials?—I was not aware of that fact, nor was I aware that you had the entire management of the work.

3957. (*Mr. Walker, for Sir Howard Douglas.*) Do you consider that the force with which the seas act upon a surface opposed to them is greater upon an upright or a sloping surface?—As the question has reference to a breakwater, I think if its perpendicular face springs from a point at which a wave would be when lowest, and rises above that at which it would be when highest, the action of a wave is less against a perpendicular face than upon a sloping one. In all cases of sloping breakwaters that I have observed, it is not the upward action of the wave only that does damage to the slope; the recoil of the wave is almost as injurious. But it should be remembered that we have recourse to sloping breakwaters in order to make cheap materials stand in the place of expensive labour. In order perhaps to draw a fair comparison of the effect of a sea on a sloping and perpendicular wall, one would like to see the same degree of care used in making the slope as is common in building a wall.

3958. My question was rather a theoretical one?—In theory I think it will be less upon an upright wall, under the circumstances which I have assumed, that is having reference to the time during which it acts, and the surface upon which it acts.

3959. With respect to Dover do you think that there will be any great fear of that extent of harbour silting up, namely, the extent enclosed within the largest projected lines of breakwater, forming an area of 500 acres?—Not with an opening of 500 feet only. At least I should be quite content to consider it as a permanent harbour.

3960. Do you know any instance of any harbour silting up by the action of the sea-water?—Not as a parallel case to this. We have some instances of harbours upon our coasts that have accumulated sand and silt to a degree which may be called destroying them.

3961. To what harbours do you allude?—Rye, Hastings, and other harbours of the same class, along the eastern coast.

3962. They are tidal harbours?—Yes.

3963. Do not you think that in most of the harbours we hear of as having silted up, it is chiefly due to the streams which come from the country, and are allowed to run into them?—No, I do not; I do not think so much injury is done by the rivers emptying into our large estuaries as many engineers do, because in many of our large estuaries, where great and rapid changes are taking place, the rivers running into them are too insignificant to effect those changes. It would be absurd to attribute them to any matter brought down by such rivers. In all small harbours, it is a great object to keep away indraught. I believe if you have a harbour with a long estuary attached to it, up which the tide flows, and you have a very great indraught, the chances are, if the harbour has a large mouth, and a place where the matter carried in by the indraught can accumulate without being acted upon again by the return stream, the indraught in such a case is a positive injury. I would wish to draw this distinction, where you have a harbour with a very large mouth, and a strong indraught on a sandy coast, bank will be formed in places out of the reach of the ebb-waters, and of course the bank become permanent accumulations. I should say the most perfect harbour of that sort you could have upon a coast encumbered with sand or shingle, would be by letting the tide enter through one mouth and ebb by another. That is, to let the stream fill the estuary by a separate mouth,



and come out by the harbour's mouth. An arrangement of that kind is much more likely to prevent silting in a harbour than where the stream runs in and out by the same entrance. *J. M. Rendel, Esq.*

3964. Supposing the projected breakwater to be carried out in Dover Bay, would it not be desirable to turn the small stream which now runs into the harbour to the east or the west?—I think it would. I cannot see any objection to it. No good could possibly arise from the stream, and it might do harm.

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3965. If a breakwater were constructed nearly parallel with the coast, which I apprehend is in the stream of flood-tide, do you consider, the breakwater being two miles long, that any ill consequences will arise from silt or deposit within the line of such breakwater?—I think not, if the line of breakwater does not interfere with the line of the currents; that is, having ascertained what is the prevailing line or direction of the tidal currents, the breakwater should be made parallel with that line, then I do not believe there would be any silting up at all.

3966. It is generally stated, and has been proved, that Dungeness is growing from an accumulation of shingle in the direction of the point; the shingle working both ways, that point is said to be extending, should you apprehend any obstruction to a harbour of refuge within such a breakwater as this, which has been described to you from the shingle accumulating on that point?—I think the building of a breakwater would be one means which an engineer would adopt for preventing the further accumulation of shingle at that point. The placing a breakwater judiciously in that position must increase the shore-currents. I take it for granted that the growing up of that point is due entirely to that being the meeting place of two currents, which are so nicely balanced that neither prevails. Give a preponderance to either, and the effect will be very different. I think that an admirable position for a breakwater.

3967. On what ground do you think it an admirable position for a breakwater?—I think you would have less liability to injurious change arising from the construction of a breakwater there than in any other place to which my attention has been called; and if any change takes place, the effect will be to prevent the further accumulation of Dungeness Point and that would be desirable rather than the contrary.

3968. Is it not a highly desirable thing to encourage the lengthening out of that point on account of its giving such an admirable protection to the bay?—I am afraid we do not look to the ultimate consequence; let that process go on to a great extent, and instead of the point becoming the means of sheltering the bay, the bay will become shoal. Suppose this point to grow up faster than the shore of the bay, the strong current along the shore, to which you owe the deep water would be lost, and give place to quiet water, or a repose in which the shingle would accumulate. The point would then again grow up, and the shore would again accumulate as before. Of course as the accumulation advanced into deep water, they would be less apparent, and might be altogether stopped after reaching a certain degree of exposure, but the shore would participate in every advance of that point.

3969. Is there not at all times risk in interfering with the natural operations of that point, that what you propose as a breakwater may have the effect of doing mischief, which you do not contemplate?—Of course there is always risk, if you at all interfere with natural operations. You may change them for the worse instead of for the better; but I have always found that in building breakwaters, or other works in the sea, the surest plan not to produce those prejudicial consequences is to go with nature, and to build in the line of the currents; if you do so, the chances are that you will make those currents work with you, instead of against you. For instance, here I have referred to this fact, that the point must grow out from the circumstance that you get a balance of forces on each side of it, and the consequence is that a kind of eddy is formed which produces that point; if you build a breakwater along here, the consequence will be, that you get a stronger in-shore current than at present, and that will necessarily make the forces on this side more active than the forces on that, and instead of the point growing in this direction, it will go in that direction.

3970. Have you ever been at Dungeness?—I have been there, but not professionally.

3971. Are you aware of a shoal extending from the front of where the breakwater is proposed to a considerable extent, and then falling suddenly into deep water?—I am aware that there is shallow water here, but then there is deeper water outside, and that is a corroboration of what I have said about the formation of the point; if that point grows, the shoal will come further out, you do not make a larger bay, from the growing out of that point. The bay sympathizes with the growth of the point, and if the point accumulates, the bay will accumulate. You will only maintain a deep bay, by inviting a stronger current along the shore, which a breakwater judiciously designed would secure.

3972. As this point extends out, you admit that it forms a better shelter and protection to the bay?—If you could induce nature to form a point here, to the extent which would afford the protection you desire, without carrying on the same process in the bay at the same time, then the growing up of that point would increase the shelter in the bay; but if the filling up of the bay is to keep pace with the growing up of the point, no advantage results, and that I anticipate; my conviction is, that you cannot induce the growth of this point by the operation of the natural currents, without the shore sympathizing with it. Old charts have been referred to—a chart made 100 years ago; any one who would draw a conclusion from it must have more confidence in charts of that date than I have; I am satisfied they are not at all to be trusted. I do not know an instance where a point has grown up from a balance of currents as this point has, where the shelter of the point itself has not brought shallow water along the shore.

3973. Are you aware of the state of this beach, and the difficulty of landing?—Yes.

3974. If a breakwater were built here, would it not be necessary to build a harbour also?—I think you must, to make a perfect harbour, here, have an inner harbour, where pilot-boats



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and stores might always be kept, and assistance readily rendered to vessels. That is rather a favourable position for such a small harbour, but I should like to be quite understood about the growing up of this point, for these are subjects to which I have paid a great deal of attention; supposing a breakwater to be built along here in the direction of the current, every one will admit that the current would be strengthened on the inside or shore side of the breakwater, and the effect would be, not only to prevent a further accumulation of shingle within the breakwater, but to remove a portion of that which is now there, and increase the depth of water.

3975. You do not anticipate that Dover Harbour, on the plan that has been adverted to, would be in danger of silting up?—If you make Dover Harbour of the proposed capacity, viz., 500 acres, with an entrance of not more than 500 feet, I do not believe that it would silt a foot in depth for 30 or 40 years. We should always remember that the filling up of a harbour of this kind is due to the size of the opening, all other things being the same. The sea which carries matter in suspension rolls by the entrance, and if there is any matter in the waves, a portion of it goes in. It is manifest, therefore, that the quantity of deposits must depend upon the quantity of matter so transported by the sea; and the quantity which gets into the entrance must be manifestly due to the size of the entrance; and I have observed, invariably, that in all situations where you have large and small basins under precisely the same circumstances, if the entrance of the large basin is of the same size as the entrance to the small one, the accumulation in the large one is not at all in proportion to that which takes place in the smaller one.

3976. The subject of a breakwater to enclose Portland Roads, having been under the consideration of the Commissioners, you are requested to examine the sketch before you, and state your opinion as to the direction, materials, and form which you would recommend to be adopted for that breakwater?—I should say, in the first place, that before anything at all is decided upon as to sheltering Portland Roads by a breakwater, it is important to know the nature of the base of Chesil Bank. There again we see a bank formed by the effect of the tidal currents and waves. If this bank is entirely a mass of shingle, then by sheltering it on one side, and leaving it exposed on the other, I am not sure that it would retain its position. I think, therefore, it is very desirable before you even discuss the subject of this breakwater, to know exactly the nature of the ground upon which the bank is formed; if it is a mass of shingle to below low water, and you were to make this side so sheltered as it would be by the proposed breakwater, leaving that side unprotected, I am not satisfied that you would have a permanent harbour,\* otherwise the large extent of deep and admirable anchorage which the proposed breakwater encloses makes it a very desirable work.

3977. Suppose a breakwater were built there, would you have an opening which should be convenient for ships in particular winds, when they could not get round the north point?—You might find that a desirable convenience under the circumstances referred to; one does not, however, like more openings in a harbour than are necessary.

3978. Where would you put the opening?—As much to leeward as I could with propriety; I mean nearest to the shore; I say to leeward, because the north-north-west winds are spoken of as the winds which would prevent the vessel getting out.

3979. It has been suggested that vessels coming out with a scant wind would have a lee shore the whole way out, does that make a difference?—Much of the object would be lost by having it far to windward.

3980. What do you think of one-third from the shore?—The utility of the opening would be impaired every foot that you went to windward, particularly as you have such a large portion of the bay already to leeward.

3981. What do you think of a distance of one-third from the shore, whatever the breakwater is?—I think that would be the extreme limit of usefulness.

3982. You recommend an upright breakwater?—Yes, where the water is so deep that you could bring up bold and abrupt slopes to within a few feet of low-water spring-tides, and upon them rear the perpendicular walls.

3983. You would recommend an upright superstructure, standing on a foundation of a slope up to near low-water mark?—Yes.

3984. Would you recommend the slope to fall into a vertical line by a curve, or would you have an angle?—When I had brought up the work to within a few feet of low-water, I should round off the top, and make it as solid as I could, by packing of some sort, and then build upon that the perpendicular walls, but not till after it had acquired the requisite degree of solidity, which it would in two or three years.

3985. Assuming that interval of time, would you recommend that such a work should be executed by building it from the bottom with large masses of solid stones, or by means of caissons filled in with concrete, or with any other substance and sunk?—I should certainly hesitate to a very great degree before I attempted to form even a nucleus for a breakwater in 7 fathoms of water by means of caissons; I know that caissons of infinitely smaller dimensions than those which would be required for a work to be founded in 7 fathoms water are difficult to be managed in a rapid tideway, and under the ordinary risks of building in water, and I certainly feel that the readiest, safest, and in the end, the least expensive way, would be to drop the materials in their place in the ordinary way; I should prefer dropping the materials perpendicularly to throwing them in over an end embankment.

3986. And you think that a work so constructed would be the most solid, and, ranging over a long period of time, would be the least expensive?—Yes.

3987. Do not you think that, in that depth of water, it would be more expensive than a common rubble wall?—Yes.

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\* Since Mr. Rendel's examination, Sir Byam Martin has ascertained from C. A. Maning, Esq., of Portland Castle, a gentleman of great local information, that the base of Chesil Beach is clay.



3988. Could you make stone, thrown down, stand at the abrupt angle indicated in the section of Colonel Jones?—In Mill Bay Pier, at Plymouth, I took a great deal of precaution to form the slopes; I had a line of rails laid on a stage, with the intention of using a diving-bell for preparing the slope sufficiently deep for a steamer to come alongside. To my great astonishment, on taking the sections, even in the deep part, I found that the materials had stood at a slope of four inches to a foot.

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3989. Would you recommend the interior face of the profile to have a little slope?—I should say that, in the superstructure, a batter of two inches to a foot would be desirable for the upright wall.

3990. What was the size of the stone which you spoke of as standing four inches to a foot?—About one-third of the whole mass was from 6 tons to 2 tons, one-third from 2 tons to 2 cwt., and the rest what is ordinarily called rubble.

3991. With reference to the Portland Roads, are you of opinion that the construction of a second entrance would be injurious to the breakwater itself, or would it materially add to the expense of the work?—It would add to the expense of the work, because an entrance without perpendicular heads would really be a great nuisance to the harbour, and, if brought up with perpendicular faces, they would be expensive; it would, therefore, be more expensive decidedly, but I should say not materially so; having reference to the whole of the circumstances, I do not think it would add materially to the expense, nor do I think it would be injurious to the work.

3992. Do you know Newhaven Harbour?—I am professionally acquainted with Newhaven Harbour.

3993. Supposing it to be desirable to improve Newhaven Harbour, are you prepared to give the Commission any opinion as to the best mode of carrying it into execution in order to increase its capability for receiving armed steamers, and for the more easy access of merchant-vessels seeking shelter there?—This is a case where I think the harbour would be better maintained by having no indraught at all. I doubt very much if you were to extend the present pier so ut, even into two fathoms water spring-tides, and allow the indraught which now exists, whether the channel would not fill in to its present depth of two feet at low-water; I doubt whether you could keep it deeper. The indraught is quite sufficient to take in more sand than the back-water would bring back. If this wall could be lengthened and the harbour enclosed by another wall in this direction, leaving the present harbour's mouth as the filling mouth, and diverting the water of the ebb-tide through that new mouth, we should then maintain deep water along this wall, in all probability, quite out to the entrance.

3994. Do you mean that you would have two channels?—I mean this: assuming that the harbour is filled by the present entrance, then it should be emptied by the new entrance; then you would get rid of all the indraughts through the new harbour, and have nothing but the outward current. If you have an indraught through the piers the sand would get in and fill up in this corner; but if you could have the harbour filled by the western mouth, and emptied by the eastern mouth, it would be otherwise.

3995. How would you effect that?—You might effect it in many ways. It might be done by gates across here, by self-acting gates, opening with the flood-tide and closing with the ebb. Some such plan as that would be the only one which you could look to for giving a permanent harbour according to this plan.

3996. (*Capt. Washington.*) What should you think of extending the western pier of Newhaven into 12 feet water, and then removing this eastern pier, and having one in the direction of Catts Mill?—I doubt very much if the result would not be a perfect failure; the whole and sole existence of the harbour at present depends upon confining the water in that narrow channel; if the water were not so confined the inward draught would fill the channel to its present depth.

3997. Do you think favourably of a breakwater in Seaford Roads?—I do not know enough of the soundings there to answer the question. I should have no fear, from what I know of the Bay, that a breakwater, judiciously placed, would predispose the accumulation of shingle. I know that the currents through here are strong and parallel with the shore. In all these cases the great apprehension is of foul currents. Referring again to Newhaven, I am afraid that by merely extending the piers out into deep water you would not be able to maintain that deep water at the point where you would terminate them. I think the inward draught would be sufficient to take the sand into deep water between those piers, whilst the outward draught would not be sufficient to remove it.

3998. (*Chairman.*) Suppose ultimately there should be a breakwater here, and it was desirable to have a basin here, do not you think that Catts Marsh would be a good position for it?—I think it is an excellent one, if you could bring that pier from Seaford Head, restore the back-water, fill the estuary through this mouth, and empty it by that opening into the new harbour, that would be a good plan.

3999. Do you mean to empty it by means of gates?—No, I do not mean to empty it by means of gates; all I want to see is the removal of all indraught from the new harbour, which does more harm than the river and tide upon its ebb can do good.

4000. In the event of its being determined to form a harbour at Newhaven, for the coaling and refitting of steamers simply, do you anticipate any difficulty in forming such a harbour?—I think you might, with some degree of certainty, at a moderate expense, make a harbour which would give you from six to eight feet of water at low-water spring-tides. I do not think, without a very great expense, and altering the whole circumstances of the harbour as at present existing, that you could maintain a greater depth of water than that.

4001. Not 12 feet at low water?—I do not think you could.

4002. Do you think that there is much deposit in Newhaven Harbour from the stream



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that flows into it?—No; and what deposit there is from the upper country is almost all soluble matter. Except as the medium of forming a kind of mud concrete, which is very formidable to remove by scouring, I do not think that there is any harm to be anticipated from the river deposits.

4003. In the event of the channel being dredged to a general depth of 12 feet at low-water springs, do you not think that an outset running at the rate of five knots an hour, which it does, would maintain it clear?—If, after you had got the channel dredged 12 feet deep, you could maintain the outset at the same rate as it now runs in the present channel, which is two feet deep, I think it would; but there is the difficulty, as you increase the sectional area of the channel, the quantity of water being the same, you of course decrease its velocity. The very fact of your increasing the depth is tantamount to reducing the velocity.

4004. Admitting that it was reduced to the rate of three miles an hour, would not that be sufficient to keep it clear?—I think a velocity of three miles an hour would drive out all the matter which the river brought down, and all the light matter brought in by the sea-water. I do not think there is any such matter which would not be held in suspension in a current of three miles an hour.

4005. If you dredged to a certain depth, you think that, being a stiff clay, it would maintain that channel?—I think so.

4006. You are aware that the present velocity of five knots an hour causes great difficulty to vessels entering the harbour; would it not be a benefit to the navigation if that rate were reduced to three knots?—No doubt about it; it is one of the difficulties. The fall which takes place immediately within the pier-heads: I have known a vessel thrown full on to the pier-heads, and there is great difficulty in keeping them off.

4007. What steps would you take for bringing the harbour to the state that you describe?—I would increase the quantity of back-water as much as I could by restoring those marshes from which the tide has been excluded: and I would prolong the present piers into 8 or 10 feet water, and dredge the channel down to that depth into the strong clay, and then I think you might be able to maintain a depth at the entrance of from six to eight feet; but I doubt whether you could hope to maintain a greater depth by the mere scouring power which you have at Newhaven.

4008. With that sort of bottom it would not do probably, though it might in sand, to use a kind of dredging vessel, which disturbs the mud without filling barges with it?—After you had built your piers, I think you might harrow out the mud without bringing it up in the bucket. Let what would be buckets in the ordinary dredging-vessels be harrows, so as to cut up the mud, and then I think you might very well afford to scour upon the ebb, and let the tide carry the soil out to sea. I do not think that there would be any fear at all, if you did it at that time of tide when the current is strongest, but that it would be carried to sea.

4009. What width of piers would you recommend, all circumstances being taken into consideration?—If the harbour is to be principally for the accommodation of steamers, I would have the width between the piers a minimum size.

4010. That being how much?—I should not make it much more than what the piers are at present.

4011. Have you any knowledge of Harwich Harbour?—I have.

4012. Are you aware of the lengthening out of the Languard Point and the wearing away of the Beacon Cliff?—I know that one of those points is growing up because the other is being worn away.

4013. Are you aware of the cement-stone being taken away from Felixstow?—I recollect hearing, when I was at Harwich, that people had been fishing up cement-stone there, and that they had prevented its acting any longer as groynes. I very much doubt whether that is the cause of all the accumulation here.

4014. Suppose it to be so, do you believe that groynes along here would supply the deficiency?—No; I think not. Taking the thing as it is, we have these facts, that the west shore has been washing away, and that the east shore has been growing up, which, if I read nature aright, implies that the quantity of water which the estuary contains is only capable of keeping open a certain width of mouth, and that if the mouth on the one side is enlarged, it would be contracted on the other. I think, therefore, that by this plan of carrying out a pier from Beacon Cliff to Cliff-foot Rocks, you would so far contract the entrance to the harbour, as to enable the water to maintain a good and sufficient channel, say, of a minimum depth of 14 or 15 feet, after having once removed the Altar and other shoals, which interfere with this depth, and that might be easily done, as those banks are more or less formed of cement-stone; a small bounty given to the men who get the stone would induce them to take it from there instead of the other place.

4015. That is all that you would recommend with the clearing of the channels?—And a protection wall under the cliff in Mill Bay.

4016. The groynes which they are going to place there would be unnecessary in that case?—Yes.

4017. In recommending a protection wall to be erected to the westward of Beacon Cliff, do you recommend that for the purpose of protecting the land behind, or for the protection and improvement of the harbour?—I think, by building the pier, you would increase the action of the sea upon the shore in Mill Bay, and it would be nothing but fair to the proprietors, and indeed needful for the security of the pier itself, as the sea might otherwise get behind it. Undoubtedly, by building this pier the sea would strike and gather upon it, and act upon the shore with greater violence, and therefore you would put the landowners in a worse position than they are in at present, which I think you ought not to do.

4018. Would the protection-wall, built in the direction you have shown upon the plan, fol-



lowing up the principle which you have just described, induce a greater action of the sea upon the land to the westward, and would that again oblige the wall to be carried farther, and so on, indefinitely?—You would gradually reduce the sea by breaking it upon the shore, instead of discharging it upon a point, which if damaged would defeat your own purposes. If you discharged the sea directly into this bight, you would soon have the Beacon Cliff separated from the main, for the sea would very soon get behind it. These are all very friable cliffs, and immediately the sea takes away the beach from the foot of the cliffs, down comes the face of the cliff, and you would have sooner or later to build that protection-wall, or you would have the sea behind the Beacon Cliff.

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4019. Do you approve of the proposed harbour in Brixham Roads, and do you think that you would obtain the requisite shelter from that?—I think it is most important to have a breakwater in Brixham Roads, but to have a large and effective work there is far beyond the means of the local parties.

4020. Is it not a great pity that the want of funds should prevent the breakwater being extended from Shoalstone Point, and thus a sheltered roadstead afforded for all ships likely to resort there?—If they could have obtained public funds I should have proposed the breakwater from that point, but that is beyond the local means.

4021. From Shoalstone Point to what distance would you go?—I should have gone off about 1000 yards from Shoalstone Point.

[The Witness withdrew.]

Adjourned till to-morrow at 12 o'clock.

June 20th, 1844.

Admiral Sir T. BYAM MARTIN, in the Chair.

Mr. William Stuart, examined.

Mr. William Stuart.  
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4022. (Chairman.) In what capacity are you employed in Plymouth?—Superintendent of the Plymouth Breakwater.

4023. How long have you been in that situation?—I have been employed at the breakwater from the commencement of the work in 1811; but as superintendent only since 1829.

4024. In what situation were you before you went to the breakwater; what was your employment?—Carrying on public works as an engineer, under the late Mr. Rennie.

4025. Has the breakwater sustained serious damage at different times in south-west gales, and if so, state on what occasions?—We have had several severe gales, and the work has been very much upset at different times.

4026. What was the extent of the damage in the year 1817?—On the night of the 19th January, 1817, a severe storm occurred at Plymouth, during which the tide rose several feet above the ordinary flow of a spring-tide. The upper or finished part of the work was in consequence removed, and the stones thrown over on the north or inner slope. This was the first storm that materially affected the work.

4027. What was the extent of the damage done?—I cannot say, exactly; but it was very considerable.

4028. Was it not officially stated on that occasion, that what had happened might be regarded as a fortunate circumstance, as the sea had given the slope its proper shape, and that no apprehension need be entertained of any injury to it again?—That was the report of Mr. Whidbey to the Navy Board.

4029. Did not the gale of wind in 1824 do infinitely more mischief than in 1817?—A great deal more.

4030. Will you describe the extent of the mischief done on that occasion?—On the night of the 22nd, and morning of the 23rd of November, 1824, a most tremendous storm was experienced at Plymouth far exceeding in violence, and in its destructive effects upon the breakwater, any that had before occurred since the commencement of the work. The wind was from S.S.E. to S.W., and the tide rose seven feet higher than the usual rise of spring-tides, and three feet higher than ever before witnessed at that port. At this time 1241 yards in length of the work were finished in a rough state, of which 796 yards were overturned during the storm, which was only of a few hours' duration, leaving only 445 yards remaining, not much damaged at the east end of the main arm. The slope, as left by the sea, from low water upwards, was about 5 feet horizontal to 1 foot perpendicular, and in some places rather more. Messrs. Chapman, Jessop, and Rennie (the late Mr. John Rennie), engineers, were called in to report; and it was thereupon determined, in April, 1825, that a breakwater should be formed regularly from the level of low-water spring-tides, with a casing of rough squared blocks of granite and limestone, commencing on the exterior, or south slope, with a slope of 5 to 1, as the sea had left it; and on the inner, or north side, with a slope of 2 to 1. It was also determined to change the centre line of the breakwater, by placing it 39 feet 6 inches to the northward; thus leaving the great body of the stones to seaward, and increasing the slope, it being much easier to extend to the northward than the southward. It was also determined that the width on the top should be increased from 30 to 45 feet.

4031. What was the object of increasing the breadth at the top?—To add to the stability of the breakwater.

4032. Did you bond it together?—Yes; by masonry on the south slope and top.

4033. In the shape of parapet or facing?—Not parapet, but facing or casing out; the whole top was paved. From this period the work proceeded as before described, until 1830, when it was found necessary still to add to the seaward slope, by depositing above 600,000



Mr. William Stuart. tons of stone, as a foreshore, 50 feet in width from the toe of the slope, at low water, at the west end, and 30 feet at the east end of the main-arm.  
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4034. Was there any alteration of the slope when that addition was made?—There was no alteration in the slope; the 5 to 1 remained; but in 1833 it was determined to complete the extreme western end of the breakwater with a circular head of solid masonry, with an inverted arch, as the foundation of the lighthouse. The work continued accordingly until 1836, when it was considered advisable by me to make a proposal to the Board of Admiralty, which was submitted to, and approved by Mr. Walker, for continuing the south radius of the circular head to the north side, in order to extend its base. To extend the base was easy in execution, and as cheap as if it had been done according to the original plan. During a storm in February, 1838, a great quantity of stone was removed from the foreshore at the west end, and thrown over to the north side, and a portion of the masonry, where unconnected, or in an unfinished state, was likewise disturbed. In consequence of these circumstances an extension of the foreshore, at this part, was agreed upon. Another severe storm, in November of the same year, producing similar, though not equally extensive results, gave rise to the construction of a buttress. The object of this buttress was not only to secure the foot of the south slope, but also to afford protection to the proposed lighthouse, and to prevent the stones composing the foreshore from being rolled over to the north side. The buttress, as well as the work round the west end, at the foot of the slope, at low-water, are composed of granite masonry, dove-tailed horizontally, and vertically fixed with iron Lewis-cramps, the rough blocks formerly deposited being first removed, by the aid of a diving-bell, to the depth of from 3 to 5 feet below low-water, and the masonry then laid at the above-mentioned level. So great is the force of the sea at this part of the work, that stones of 10, and even, 15 tons weight have been taken from below low-water, and carried over the top.

4035. From how far below low-water mark?—I believe from 4 to 8 feet.

4036. What number of yards distance do you suppose the stone was carried altogether?—From 50 to 60 yards.

4037. Will you state the size and cost of the stones that were used?—According to the first contract, made in 1812, for quarrying and carrying to the wharf, the sizes and cost were as follows: namely, stones of half a ton, and not exceeding two tons in weight, 1s. per ton; exceeding two tons, and not exceeding three tons in weight, 1s. 2½d. per ton; exceeding three tons, and not exceeding five tons in weight, 1s. 5d. per ton; and exceeding five tons, and not exceeding ten tons, 1s. 8d. per ton.

4038. What is there in addition for depositing it?—2s. 10d. per ton for removing from the wharf and depositing at the breakwater.

4039. What was the total expense of a ton of limestone from the quarry until deposited in the blue water?—About 4s. 6d. per ton, by the terms of the first contracts.

4040. For how much do you suppose the Government did it afterwards?—The first contractors could not get on, they were obliged to stop; we had then to enter into a fresh contract, like the first, except that the minimum size of the stones was reduced from half to a quarter of a ton, and to give for quarrying and carrying to the wharf about 3s. per ton; but not more for carrying out.

4041. How much more in the total?—1s. 4d. per ton.

4042. In the construction of the breakwater, were any precautions taken to throw down the small stones to fill up the interstices?—There were no precautions taken until 1816, for filling up the interstices, except by the use, to the fullest possible extent, of the sizes now given; but in 1816, the late Sir Joseph Yorke and Mr. John Rennie (I having always been an advocate for small stones) agreed that much smaller stones should be used for this purpose, and which was ever afterwards accordingly done.

4043. Can you state what was the expense of making good the damage on the occasions you have mentioned?—In 1838 the damage was about 1300l.; but with respect to the others my predecessor, Mr. Whidbey, never wished to go into particulars, or kept any account.

4044. Is it the case that you have constantly to make good in the summer the damage of the winter at the present time?—No.

4045. Is there not generally 15,000l. voted for the breakwater in each year?—Yes.

4046. Is that for repairs?—For proceeding with the work.

4047. Is the work not yet complete?—No.

4048. How many years has the work been in hand?—Thirty-two years; but the breakwater, although unfinished, has long been efficient for the protection of vessels.

4049. Do you attribute the damages you have stated in the years alluded to to the form and shape of the breakwater, and to the want of filling up the interstices?—In the first gales I attributed the damages to the fact that we had not length enough of foreshore, or of extension to seaward.

4050. Not slope enough?—Not slope enough.

4051. Have you given much consideration to the slopes of breakwaters generally?—I could scarcely help doing it from the position I have held, and at one time Mr. Whidbey was desirous of having the upper part of the breakwater from nearly low water with a very small inclination.

4052. Do you recollect what was the inclination?—It was so small as nearly to approach to a perpendicular.

4053. Did Mr. Whidbey suggest this, considering that the slopes which had been previously adopted were injudicious?—Yes; and he stated to me, when I objected to his new proposal, that the pier at Statten Point had stood, with a small inclination, and he thought a breakwater would do the same.



4054. What was the objection you had to the more upright slope?—I was convinced it could not stand; and my belief was afterwards confirmed by the actual failure of a solid part of the breakwater, which had been built on this plan, and also by the failure of a part of Statton Pier itself, which had never to encounter anything like so severe a test as the breakwater.

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4055. From your long experience of the breakwater, would you, if the work was to do over again, adopt the same slope?—I should.

4056. Would it not be desirable to raise it higher, to prevent the sea rolling over?—I do not think it would; as the sea is completely broken and lost when it rolls over.

4057. Does the water, when it comes over the breakwater in that way, disturb the Sound much?—Not the slightest.

4058. Has the depth of water in Plymouth Sound diminished much since the breakwater was constructed?—It was ascertained in 1842, that the depth had not at all diminished.

4059. You state that in the year 1824 about 800 yards of breakwater were overturned?—Yes.

4060. Do you think if the breakwater had been constructed in any other form, for instance, if it had been either wholly upright from the bottom of the sea, or upright from about low-water mark, that such a breakwater would have had power to resist the force of the sea which overturned that large portion of it which you have mentioned?—I think not.

4061. Do you think that oblique planes of breakwaters, built in the sea, are better calculated to resist the force of the sea in the direction of motion than any upright work?—I do decidedly.

4062. But in cases where you would erect any superstructure on a breakwater for batteries, or any such purpose, would you erect that superstructure, continuing your slope, or in what other way?—By extending the exterior slope, and building on it afterwards, up to the crest.

4063. Having said you prefer a sloping breakwater, as best able to resist the force of the sea, you further state, from your own experience, you think the long slope of 5 to 1 is that which is most likely to remain in a state of stability?—I do.

4064. What is the total number of tons of stone deposited, up to this time, for the Plymouth Breakwater?—3,514,885 tons. The original estimate was only 2,000,000 tons.

4065. Are you still quarrying?—Yes, and carrying out. The original estimate for the breakwater, taking in some other works in connexion with it, was 1,161,100*l.*, and the total actual outlay (of which about the sum of 100,000*l.* remains to be expended during the next five years, when the whole work will be completed) will be within 1,500,000*l.*

4066. You are speaking of this exclusively of the works in Bovisand?—No; inclusively.

4067. Have you bestowed much reflection on the numerous projects, of which we have heard a good deal lately, or any of those taught by your profession, for constructing breakwaters or piers in deep water by means of caissons, by means of large blocks or masses, either of stone or of concrete, placed in wooden caissons or in cast-iron caissons, and in great lengths, so as to float them out in the line of the breakwater, and to sink them there with any confidence that the masses of masonry so laid would remain undisturbed, and as capable of resisting the force of the sea as if they had been built upwards from the bottom by the aid of a diving-bell, or the other resources you can apply?—I have given consideration to these numerous projects, and consider them likely to answer only in very quiet water, and not in such exposed situations as Plymouth Sound.

4068. Besides the difficulty of sinking these vessels from the disturbance of the weather, do you think it would be possible to build partially great masses of masonry in long caissons, or of any considerable length, and to sink them upon that bottom without piling; do you think that a breakwater, so constructed, would be likely to endure as long as a breakwater built of solid masses of stone from the bottom upwards?—If I were going to construct a breakwater I should begin nearly in the same way as has been done before, but in a much less expensive manner.

4069. How would you propose to do it in a less expensive way?—I would begin by throwing in stones and getting the whole up to low-water mark, letting them find their own base in the first instance, with rubble stone, large and small together, and then that would become a protection, and the sea would level down and you could add to it again.

4070. Would you carry it up to low-water mark?—Yes.

4071. You would still continue the slope of 5 to 1?—Yes.

4072. Do you think, upon the whole, that constructing a breakwater, say in six or seven fathoms, in that manner it would be more solid, more enduring, and perhaps in the end more economical than by any other of these projects of caissons?—That is my impression, and proceeding with a diving-bell or with caissons, would be certainly more expensive. There have been projects for putting caissons down in the centre, and then afterwards laying stone and rubble, both inside and out. That I should object to entirely, because if you put a solid body in the middle and then rough stones again they would blow out.

4073. Why do you object to that?—Because the solid body in the centre would resist the air and the sea, and blow up what is outside. We know that from experience.

4074. How do you know that from experience?—By building up solid masonry at the end of every year at the west end; when a storm came, that solid masonry caused some of the stones to be thrown up. The action of the sea blew up a few of the stones.



Mr. William Stuart.

20th June, 1444.

4075. That solid masonry is on the top of the rubble, whereas the proposition you are now alluding to has the solid masonry below and the rubble above?—So much the worse.

4076. In your replies as to the price of stone in the first and second contract for the construction of the breakwater, did the 4s. 6d. and 5s. 10d. respectively, include all the expenses of bringing off the stones and depositing them?—No.

4077. What additional expense was there?—The expense of superintendence.

4078. What was the smallest description of stone originally used in the construction of the breakwater?—Half a ton in the first contract, and a quarter afterwards. Subsequently Sir Joseph Yorke and the late Mr. Rennie, on visiting the work, authorized, at my suggestion, the use of much smaller stones, and subsequently still, what we call quarry rubbish has been also used.

4079. Since what date was that?—Since 1816 as respects the smaller stones, and since 1830 as respects quarry rubbish.

4080. You wished in the first instance to have small stones?—Yes, always.

4081. Is there anything more you wish to add?—I will deliver in this paper. (*The witness delivered in the same.*)

4082. You say you think there has been no deposit in the Sound. Have you ever sounded it?—Frequently.

4083. How much stone has been taken up from the bottom of the Sound and placed at the top of the breakwater?—We removed one rock by means of the diving-bell, which I should say, from recollection, was from 500 to 600 tons.

4084. What is the extent of the injury done to the breakwater by the worm and other animals that attack it?—A mere bagatelle, of no consequence whatever. The pholas, a small shell-fish, gets into the stone, but only between low-water of the spring-tide and low-water of the neap-tide, and does not cause it injury at all. I have never known the pholas bore in the stone more than 3 inches; it goes in like a pin point; and at that depth it is probably nearly about a quarter of an inch in diameter. When we were removing the stone in the interior with the diving-bell, we never found any of them; they are only at the outer extremity.

4085. What price are you now paying for the freight of stone?—10d. by contract; but by Government, more.

4086. Do you mean in Government vessels?—Yes.

4087. What makes the difference?—The Government vessels carry out all the heavy stone.

4088. Is it more economical to do it by contract?—Doing work by contract, which is merely for quarrying stone or for carrying out, I think is the cheapest mode; but in a public work like the Plymouth Breakwater, I would not employ contractors to do a particle of the work outside. I am convinced that since the management has been by Government officers we have done it a great deal cheaper.

4089. Can you give any opinion as to the proportion between the cavities within the breakwater and the solid parts?—Supposing the weight of the stone to be 13 feet per ton, I think a ton of stone occupies from 15 to 16 or 17 feet of space of the breakwater, taking the mass.

4090. (*Lieut.-Col. Colquhoun.*) What is the largest piece of stone you have ever deposited in the breakwater?—The largest limestone has been 20 tons weight. After the first gale of 1838 we put down stones of 15 and 20 tons weight, and some of those were rolled over.

4091. Was that limestone?—Yes.

4092. What was the weight of the granite?—None exceeding nine tons.

4093. Did you in proportion find the granite roll over as much as the limestone?—The granite was all used as masonry, which was dove-tailed both horizontally and vertically and could not roll over; it could not get out.

4094. Was any part of that granite ever rolled or washed out either vertically or horizontally?—Yes; there were a few stones towards the west, and that were only dove-tailed horizontally.

4095. What weight were those stones?—Five tons.

4096. Were they lifted up by the sea?—Yes. Those were not dove-tailed vertically.

4097. How were they secured?—Laid joint to joint; and I conclude that the solid masonry checked the sea and caused the stones to be blown up; but only a few in 1838.

4098. Is it your impression that the granite lie quieter than the limestone?—Not at all. The limestone is heavier in proportion than the granite.

4099. What is the specific gravity of the Plymouth limestone?—13 feet per ton.

4100. What is the weight of the granite you use; how many feet per ton?—14.

4101. Where does the granite come from?—A great deal came in the first place from Dartmoor; but latterly from Fowey.

4102. Have you ascertained the specific gravity of each?—I have.

4103. Which is the heavier?—I think they are very nearly the same.

4104. Was not the original plan which was recommended by Mr. Rennie and Mr. Whidbey, to have a part of the breakwater above low water nearly parallel, and was not their original estimate founded upon that?—I believe it was, though until lately I never saw any drawings of it.

4105. Was any part of it ever made upright?—Never.

4106. So that the upright building was never tried?—Never.

4107. In what degree do your soundings in Plymouth Sound differ now from Mr. Smith's soundings in 1792, or is there any difference?—I think only a slight difference, just within the breakwater.



4108. To what extent from the breakwater has it shoaled?—Not half a cable's length. Mr. *William Stuart*.

4109. To what degree has it shoaled in that part?—Probably a foot or 14 inches in some parts; and great part of that is filled up where the Shovel Rock was. 20th June, 1844.

4110. You are aware it has been said that the depth has taken the form of an equilateral triangle, the breakwater being the base, and has deposited several inches of silt?—Not so much as an equilateral triangle; round here it is as clear as ever it was. (*The witness described on paper the smallness of the extent.*)

4111. What is the greatest number of ships you have ever seen at anchor in Plymouth Sound since the breakwater has been constructed?—One hundred sail of different kinds.

4112. What number do you suppose it capable of holding of the description of vessels you have seen there?—I think you might have double that number in it, or nearly so.

4113. What is the area within it?—I do not exactly know, but Government takes a large part, where merchant-men cannot go.

4114. Have you ever known any instance of embarrassment and distress to vessels running in, by getting embayed, and not being able to get into the Sound?—Never, if they took proper precautions.

4115. What precautions?—Dropping anchor in proper time, by neglecting which a Dutch vessel coming in with an easterly wind at the east end of the breakwater, ran down towards Cawsand Bay.

4116. When running into a deep bight of that kind, have ships become embarrassed, and got embayed between the Lizard and the Praule?—I have not known such an instance.

4117. Did you ever know a ship running in with a gale of wind in the south-west, take up anchorage in the Sound part, and get aground?—I never did.

4118. Did you ever know a ship part from her anchor since the breakwater has been made?—Frequently.

4119. And run where?—Yes, into Cat Water.

4120. Did you ever know a man-of-war part from her anchor?—Yes, in 1817.

4121. What ship was that?—The “Jasper.”

4122. What became of her?—She became a wreck, and every soul perished except one man.

4123. In Plymouth Sound?—Yes.

4124. Had she not anchored down on the Scotch ground?—She was farther in than the Scotch ground.

4125. Was the work of the breakwater so far advanced as to afford any protection to the Sound?—No.

4126. Was she anchored in foul ground?—Yes.

4127. Have you ever known for the last ten years a ship driven from her anchor?—No.

4128. Have you ever known any difficulty in ships bringing up since the breakwater has been constructed?—Never since it has afforded sufficient means of shelter. In the gale of 1824, we had 18 wrecks at the time that the breakwater was turned over, within half a mile between Queen Anne's Battery and Monkey Dore, and owing to the sea breaking in after the breach was made in the breakwater. These vessels were all merchant-men.

[*The Witness withdrew.*]

*James Meadows Rendel, Esq., re-examined.*

*J. M. Rendel, Esq.*  
20th June, 1844.

4129. Were you engaged professionally in the construction of a breakwater at Brixham?—The lords of the manor of Brixham engaged me to design a breakwater at Brixham, but their funds are so limited that they cannot afford to pay London engineers. It is now under the charge of Parliamentary Commissioners, being inhabitants of Brixham.

4130. Was the breakwater you designed for them simply for the protection of the small harbour of Brixham?—It was, and for the shelter of vessels of 14 feet draught as were endangered by seeking refuge in the bay should the wind chop round to east.

4131. What capacity has the anchorage within the breakwater?—There are 115 acres within the breakwater which I designed; the greatest depth of water at low-water is four fathom, shoaling up to one fathom, which is almost close to the shore. The question which I was desired particularly to be prepared to answer to-day was, what would be the cost of a breakwater 1000 yards in length running off into five and a half fathom water from Shoals Point? I have made out a rough calculation of that, and I find that about 300 acres might be enclosed for an expense of 250,000*l*.

4132. How long?—One thousand yards.

4133. To what depth of water would it carry you?—Five and a half fathom.

4134. At low-water?—At low-water.

4135. What points does it shelter?—There is hardly a point that it would not shelter. Out of the 300 acres there would be perfectly land-locked at least 150.

4136. And capable of receiving the largest ships?—Yes, five and a half fathoms in quiet water. Of course there the cost would be comparatively small on account of the facility of getting materials.

4137. What is the nature of the stone or rock there?—It is remarkably compact, and solid limestone rock.

4138. Where would it come from?—The whole of Berry Head is a mass of limestone rock of a very compact kind.

[*The Witness withdrew.*]



Captain  
Geo. Richardson.

20th June, 1844.

Captain *George Richardson*, examined.

4139. (*Chairman.*) What is your situation?—I command the “Herefordshire,” in the East India service.

4140. Have you been much accustomed to the navigation of the British Channel?—I have been 34 years at sea, continually going up and down Channel in the West India and East India service.

4141. If you were called upon to state your opinion as to the best situation for a harbour, for the convenience of the trade in the Channel, and also for a squadron of steamers to watch the opposite coast and protect the commerce, what port would you select between the North Foreland and Portsmouth?—I should certainly think Dungeness the most eligible.

4142. Do you understand my question to mean for building a harbour?—I have heard that was the object.

4143. Why would you prefer Dungeness?—As a protection in south-westerly gales.

4144. I am assuming the building of a harbour, for instance, in addition to what there is at present, either at Dungeness or at Dover, or anywhere else; what place would you recommend for constructing a harbour?—For some reasons I think Dungeness, for others Seaford, according to the different winds, or Newhaven.

4145. What do you mean by according to the different winds?—For the easterly winds and the north-easterly winds, I think ships that could not get into Dungeness roads or harbour, supposing one there, might go away to Seaford.

4146. (*Sir Howard Douglas.*) Where would you propose to build a close harbour?—I think at Dungeness.

4147. For what reason would you prefer Dungeness?—Because when a vessel is in the lower part of the Channel, there is plenty of room to heave a ship to; and I think a prudent man would not run up to Dungeness in bad weather. It is only in the event of his being caught there that he would run in.

4148. In asking about the navigation of the Channel, we suppose vessels either at Beachy Head or Dungeness, or anywhere else, to feel the necessity of a port of refuge in the common ordinary traffic of the Channel; and therefore, in that common ordinary traffic, what part would be recommended as the most likely to be convenient to the trade?—I should certainly say Dungeness. Southerly and westerly gales we dread more than any other. If a ship is above Beachy Head, with a westerly gale, she could not get down Channel again, and with a flood-tide drive up to Dungeness very nearly; and probably the captain would be afraid to run to the Downs, but put into Dungeness, supposing a secure harbour there.

4149. What would make him afraid to run to the Downs?—Because nine people out of ten, I think, become nervous when they get into that part of the world. They have such a dread of the Goodwin Sands.

4150. Suppose the vessel which you speak of to be to the westward of Beachy Head?—He is not obliged to run then, I think.

4151. What would he do?—It would be better to heave to.

4152. Would you have a vessel lying two or three days in the Channel in a gale of wind?—There is now and then a gale of that kind, but, generally speaking, violent winds are not of such long duration. I have never met with the slightest accident in the Channel, and I have always found the safest thing to be to heave to in good time.

4153. Dungeness is already a good roadstead for ships in a south-west wind?—Yes, and capable of great improvement, I think. The Spit is making out much to the eastward, and I see sometimes 100 sail there lying at anchor, and a breakwater might make it secure, I think.

4154. Do you mean secure against a sudden change of wind?—I am afraid that is a very difficult thing; but I think when a vessel cannot ride at Dungeness, another harbour at Newhaven, or Seaford, might protect her against the easterly winds.

4155. Do you prefer a harbour of refuge to the eastward or westward of Beachy Head?—To the westward of Beachy Head; at Seaford, I think.

4156. Why to the westward?—Dungeness would protect them in westerly winds, and Seaford in easterly winds; besides which a vessel wind-bound could always get out in case of a sudden gale from the eastward, as wind-bound ships do from Ramsgate.

4157. (*Admiral Dundas.*) In the event of war, would it be necessary to have a harbour on the coast of Kent where war-steamers could be sheltered from all winds and weather, and constantly ready, night and day, to slip out at a moment’s notice for the protection of the trade of the coast; and, combined with that object, that of being a harbour of refuge for merchant-vessels, and what spot on the coast of Kent from Beachy Head to the North Foreland would you say was the most prominent part to form such a harbour, remembering at the same time that it would be necessary to have a harbour where troops could embark and expeditions be sent out at a few hours’ notice?—I should prefer Dungeness.

4158. Have you any particular objection to Dover as a place for constructing a breakwater?—I think Dover bad, because in bad weather a ship might be near the Goodwin Sands.

4159. You are aware that it is supposed you still have Dungeness, and a second port of refuge at Dover?—Yes.

4160. Do you think that ships would be safe in the Downs if there was a war to-morrow and the enemy had steamers in the Channel?—I should think they would be safe, for our steamers would be as good as theirs.

4161. Would a squadron of steam-vessels at Dover be nearer at hand to protect merchantmen in the Downs than if you had them at Dungeness?—Yes; a steamer can ride anywhere.



4162. If you had a harbour of refuge at any place, would you construct it on a spot where they would give more protection to the commerce of the country than any other?—One would think so; but, as a merchant-man, I am for Dungeness?

Captain  
Geo. Richardson.

20th June, 1844.

4163. As a sailor, if you are ten leagues to the westward of Beachy Head in a heavy gale of wind, and you wanted anchorage, if you had a harbour of refuge off Seaford, and another to the eastward of Beachy Head, which would you run to?—I should go to the one to the eastward.

4164. If bad weather came on at night, would you go to the eastward of Beachy Head in a gale of wind, or, if there was a good breakwater in Seaford Roads, would you go there?—I should prefer going to the one to the eastward. I should not like to go down on a lee-shore, which would be the case in a S.W. gale at Seaford.

4165. Do you know anything of the anchorage at the eastern side of the Head?—No.

4166. Are you aware there are rocks there?—Yes.

4167. Have you ever anchored off there?—Never.

4168. What is your objection to going into a port in a gale of wind?—It must depend on my locality.

4169. You said you had an objection to going into a port in a gale of wind?—I think there is a great risk in a heavy gale of wind in running for a port.

4170. (*Captain Fisher.*) Do you object to ports of refuge generally?—Decidedly not.

4171. Where, in your opinion, would be the most desirable position to construct an asylum harbour between the mouth of the Thames and Plymouth, to be accessible at all times of tide for ships of all classes, men-of-war, armed steamers, and large merchant-ships, and calculated also, in the event of hostilities, for giving protection to the trade generally, both outward and inward bound, as may be?—Seaford or Dungeness.

4172. Do you think Seaford would give protection as a harbour of refuge?—I think it would.

4173. Are you of opinion that large ships or convoys seeking shelter or detained by contrary winds could make their passage from a harbour constructed at Dungeness in all winds and under all circumstances, when they could not make their passage from a harbour constructed off Dover?—I should think they certainly could. There is a great advantage in being down off Dungeness. Many persons would not like to start from Dover; of course I mean with a contrary wind, as from the Downs, outward bound. I think Dungeness would be much preferable.

4174. Are you aware of the course a ship would have to steer from a harbour constructed off Dover to round Dungeness?—Yes; about W.S.W., I think it is.

4175. How would she have to steer from a harbour constructed off Dungeness to round Dungeness point?—If the entrance is south-east, she may go as close round Dungeness as she likes. She must go a little to the southward.

4176. If the course from a harbour constructed at Dungeness would be more to the southward than one constructed off Dover, how would ships be able to make their passage down in a wind which would otherwise be favourable?—I suppose the tide would take them round the point fast enough.

4177. The question is, whether vessels lying in a harbour off Dover could make their passage down Channel with such a wind as they might not be able to make with a harbour constructed off Dungeness?—Supposing both of them must be to the southward—I mean the entrances.

4178. Have you ever anchored in Dover Roads?—Yes; and the water is rather deep as far as I recollect.

4179. (*Captain Washington.*) Having commanded a merchant-vessel some years, will you give your free and unbiassed opinion at what spot between the Nore and the Bill of Portland you think that a harbour of refuge would be most useful to merchant-vessels, taking all winds and weather into consideration?—I have stated Dungeness as far as my opinion goes; but I do not think that I am very competent to give one.

4180. Is that your opinion, having commanded a ship a great many years?—Yes.

4181. As a seaman, you prefer Dungeness?—Yes.

4182. If a breakwater was to be erected on the east or west side of Beachy Head, which would you prefer?—Seaford Roads, having one also at Dungeness.

4183. Do you propose to have a harbour on each side of Dungeness for every wind?—No; one at Seaford for easterly and southerly winds and one at Dungeness for westerly and southerly, &c. There would be no objection to one on each side; but it is not of so much consequence with easterly winds, because if you cannot hold on with an easterly wind, you can go down Channel. My father and I, some years ago, got up as high as Folkestone; and my father, commanding, although he had been at sea very many years, was not acquainted with the anchorage, and went back to Portsmouth.

[*The Witness withdrew.*]

Adjourned.







# APPENDIX A.

## LETTERS, REPORTS, &c., RECEIVED.

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1. Treasury Minute, respecting the objects to which the attention of the Commission was to be directed.— <i>April</i> 2, 1844—(See page iii.)	
2. Mr. Trevelyan to Sir Byam Martin, notifying the members composing the Commission.— <i>April</i> 10, 1844	
3. Sir William Symonds to Sir Byam Martin, requesting that charts may be procured and a survey made of Dungeness.— <i>May</i> 3, 1844.	
4. Sir John Barrow to Sir Byam Martin, notifying that the Lords Commissioners of the Admiralty had directed the first-lieutenant and surveying officer of Her Majesty's ship <i>Blazer</i> to make the required survey of Dungeness.— <i>May</i> 4, 1844.	
5. The Registrar of the Cinque Ports to Sir Byam Martin, respecting the letter of his Grace the Duke of Wellington, directing officers of the Cinque Ports to render any assistance required by the Commission.— <i>May</i> 11, 1844.	
6. Lord Lincoln to Sir Byam Martin, in reply to his letter of the 28th May, that the lease of the Crown Quarries at Portland had been already agreed upon.— <i>May</i> 31, 1844.	
7. Mr. Faraday to Sir Byam Martin, respecting the action of sea-water on iron . . . . .	2
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9. The Chairman of the Ship Owners' Society to Sir Byam Martin, in reply to his letter of 14th July, stating his willingness to attend if required, but suggesting that he would not be able to give much information on the matters upon which the Commission is engaged.— <i>July</i> 16, 1844.	
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Sir John Rennie, Plan and Report on the Brake and Goodwin Sands, addressed to the Trustees of Ramsgate Harbour.—*March* 15, 1842.



Proceedings of the  
Commission.

*Mr Faraday to Sir Byam Martin, respecting the action of sea-water on iron.*

*Royal Institution, June 12, 1844.*

SIR,

I HASTEN to reply to your note, though not, I fear, with any very certain knowledge, for infirm health has prevented me from taking up the consideration of the action of sea-water on iron so practically as I should have liked to have done; but I will give you my opinion and views as far as my observation and judgment will permit. I conclude that the question is of cast-iron in sea-water. Between these two bodies there is a vigorous action; as far as I have been able to observe, it is greatest in the water near the surface, less in deep water, and least of all where the iron is buried in sand, or earth, or building materials, (into which the water may penetrate); for then the oxide and other results formed, are detained more or less, and form, sometimes, a cement to the surrounding matter and always a partial protection. Soft cast-iron, as far as my experience goes, (which is not much,) corrodes more rapidly than hard cast; and the soft, gray, and mottled iron, more rapidly than the brittle white iron. As to the amount of corrosion in any given time, I have not had the opportunity of observing any good and satisfactory cases of illustration.

In estuaries and the mouths of rivers, it is very probable that great differences of corrosion will arise from the different circumstances of variable saltness, the soil of the river, if near a town, the matters brought down by the waters, &c., &c. The association of iron also with other substances, if metallic, will much affect it; thus a wharf of cast-iron might occasionally be greatly-injured by making fast to it vessels that are coppered using iron cables.

As to the protection of iron, and first by a coating: the permanency of a coat of paint, or of tar, or bituminous matter, can only be ascertained by reference to experience; of this I have none; except that in a case where coated iron sheathing for ships was brought to me, I was much impressed with the very thorough adhesion of the coat to the iron; the process was patent, and I cannot remember whose it was. Zincd iron would no doubt resist the action of sea-water as long as the surface was covered by zinc, or even when partially denuded of that metal; but zinc dissolves rapidly in sea-water, and after it is gone, the iron would follow.

As to voltaic protection, it has often struck me that the cast-iron piles proposed for lighthouses or beacons might be protected by zinc in the same manner as Davy proposed to protect copper by iron; but there is no doubt the corrosion of the zinc would be very rapid. If found not too expensive, the object would be to apply the zinc protectors in a place where they could be examined often, and replaced when rendered ineffective; in this manner I have little doubt that iron could be protected in sea-water. It is even probable that, by investigation and trial, different sorts of iron might be easily distinguished and prepared, one of which should protect the other; thus soft cast-iron would probably protect hard cast-iron; and then it would be easy to place the protecting masses where they could be removed when required.

Hence though iron be a body very subject to the action of sea-water, it does not seem unlikely that it might be used with advantage in marine constructions intended to be permanent, especially if the joint effects of preserving coats and voltaic protectors were applied. Perhaps engineers are in possession of practical and experimental data sufficient to allow of the formation of a safe judgment on this point; for my own part I am not, and therefore am constrained to express the above opinions with much doubt and reserve.

I am, Sir,

Your very obedient faithful servant,

W. FARADAY.

Sir T. Byam Martin, G.C.B.,  
&c. &c. &c.

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*Extract of a Letter from Mr. Brunel to Sir Byam Martin, on the subject of the Sea Slopes of Breakwaters, dated 19th June, 1844.*

"Upon one point upon which I understand the Commissioners to have sought an opinion, I have no hesitation in expressing my concurrence in those which I am told have been generally expressed in favour of vertical sea-walls, in lieu of slopes, where the nature of the material to be used, and other circumstances, admit of such a plan being efficiently and economically carried out."

(Signed) I. M. BRUNEL.

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*The Chairman of Lloyd's to Sir Byam Martin.*

SIR,

*Lloyd's, June 26, 1844.*

I HAVE the honour to acknowledge, with my best thanks, your letter, dated 19th instant, requesting to be informed, if I wish to state, as chairman of the establishment, the opinion entertained by myself or others, as to the most suitable position for harbours of refuge on the south-east coast of the British Channel, and to acquaint you it has been submitted to the Committee for managing the affairs of Lloyd's, and I am happy to state that they entirely concur with me in a perfect conviction, that the parties interested in British shipping will receive every consideration in the selection of suitable positions for harbours of refuge from the Commission appointed for that purpose by Her Majesty's Government.

I have the honour to be, Sir,

Your most obedient servant,

G. R. ROBINSON.

Sir T. Byam Martin, G.C.B.  
&c. &c. &c.

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## INSTRUCTIONS FOR CAPTAIN WASHINGTON.—POINTS FOR EXAMINATION.

*Harbour Commission, Gwydyr House,  
April 18, 1844.*

## DOVER.

To anchor the *Blazer* at six fathoms low-water spring-tides in front of the centre of Dover bay, and ascertain the distance this will give from the beach.

Instructions for  
Capt. Washington.

To sound and ascertain the depth of water within that position and the quality of the bottom as to holding-ground, or if any rock or overfalls be included within that space. State the soundings on a chart, but describe the nature of the bottom.

When anchored in the position pointed out, sound at short distances inward towards the shore, with four hand-leads put down at the same time, at about 12 feet distance from each other, in order to ascertain, as far as may be practicable, if the bottom shelves away suddenly so as to make an uneven surface for caissons, to be placed, as suggested by Mr. Cubitt, which, if standing on an inclined plane, might have an inconvenient leaning outward.

To ascertain if the anchorage above pointed out places the ship in the true run of the tide, also at what rate the tide runs, and at what distance from the pier-head does the tide take a straight course up Channel.

The bearings of the head-lands from the position mentioned.

The depth of water at low-water spring-tides at a distance of 200 yards from the shore, and again at 400 yards.

It having been asserted before a Committee of the House of Commons that a fixed breakwater at Dover (such as described by Mr. Cubitt) would cause the harbour to be choked up, it is highly necessary this assertion should be proved or contradicted by a most careful examination of the set of the tides, and by every possible means as to the probability or possibility of an objection, which, if true, must be so fatal to improvement at that port.

The words of the witness alluded to are as follows :—

“No harbour should be made there (Dover) by a fixed breakwater, because the diluvial matter passing up there would soon choke the harbour. All the diluvial matter that is passing up from the Ridge and the Varne runs round Dover, then passes up towards Sandwich, and gets through the Gull Stream, fortunately, otherwise that passage would be choked up.”

It is commonly understood, and all printed sailing directions for the Channel tend to confirm the opinion, that the flood-tide in the offing takes a direct course up Channel; it is therefore important that every effort should be made to ascertain if at any time of tide it takes so eccentric a direction as to run at right angles with the course of the Channel, and thus to carry diluvial matter from the Varne and Ridge shoals to Dover.

It is desirable, with reference to this assertion, to prepare a small chart, showing the position of the Ridge and Varne with respect to Dover, to include the South Sand Head, the South Foreland, and that part of the coast of France nearest to the Ridge and Varne.

Also to sound about the Varne, the nearest shoal to the English shore, and ascertain if the diluvial matter, as it is termed, corresponds with the soundings in Dover Bay.

## BEACHY HEAD AND EASTBOURNE.

To sound and carefully ascertain the quality of the bottom within the breakwater, proposed by the late Harbour of Refuge Commission to the eastward of Beachy Head.

To ascertain the set of the tide in that position, and to learn from fishermen, &c., every particular about the accumulation of shingle at that spot, and if the shingle is known to accumulate there with any other but south-west winds, and to what degree it increases at the worst times.

There is a nine-feet shoal described near to the proposed harbour, the exact extent of which must be ascertained in order to see if it renders the approach dangerous.

To ascertain at what distance from the shore there is a depth of six fathoms at low-water spring-tides; and what are the depths from thence gradually inward to the shore.

## NEWHAVEN AND SEAFORD BAY.

What is the distance seaward from the pier-heads into six fathoms at low-water spring-tides, and also to a depth of three fathoms water.

If there are any shifting sands about the mouth of the harbour.

The bearings of the head-lands when in six, and when in three fathoms water.

To ascertain the set of the tides and their strength when anchored in those positions.

The soundings and quality of the bottom between the anchorage and the pier-heads.

To examine the shore in front of Seaford to see if it is suitable and favourable to the construction of an artificial harbour.

To make such observations generally respecting the above-mentioned places as may be useful for the information of the Commission when they arrive on the spot.

The officers employed in making the observations required will be examined before the Commission.

(Signed)

T. BYAM MARTIN, *Chairman*



Report of  
Capt. *Washington*.

# REPORT OF CAPTAIN WASHINGTON.

*Her Majesty's Ship "Blazer," Harwich,  
April 29, 1844.*

SIR,

In compliance with your instructions, I beg to state that I proceeded to Dover, Newhaven and Seaford Bay, Beachy Head and Eastbourne Bay, and having been much favoured by fine weather, have been enabled to examine into all the points referred to in your memorandum of the 18th instant.

## DOVER.

**DOVER.** Dover Bay has been thoroughly sounded by us as far out to seaward as the 10 fathoms edge, and the depth of water, quality of bottom, set of tides, and eddy, are shown in the accompanying chart on the scale of twelve inches to a mile, nearly, made by Lieutenant Cudlip, and Mr. E. K. Calver, master, assistant surveyors of Her Majesty's ship under my command.

**Anchorage.** From this chart, it appears, that a vessel anchored in six fathoms at low-water springs, in front of the bay, would be at the distance of 930 yards from the shore, or rather less than half a nautic mile; that the bearings of the head-lands from such a position would be, the South Foreland, east north-east; Folkestone, west a quarter south; and Dungeness, west by south half south: the quality of the

**Bearings.** surface of the bottom, as shown by the arming of the lead, between this spot and the shore to the westward, would be dark sand and broken shells; opposite the valley, mud with 'ross' or worm-casts; whilst to the eastward of the Castle Jetty it is chiefly chalk. The only shoal within this space is one of small extent, having ten feet water over it, about 300 yards off shore to the eastward of the Castle Jetty; the depth of water in the middle of the bay at 200 yards from the shore is eight feet, and again at 400 yards, 12 feet.

**Quality of bottom.** The slope of the bottom in a section run off at low-water mark from Cheeseman's Head was found to be as follows:—

At 100 yards, being the 1 fathom edge, 1 in 50,				
150	"	"	2	" 1 " 25,
175	"	"	3	" 1 " 12,
200	"	"	4	" 1 " 12,
225	"	"	5	" 1 " 12,
Making the general slope				. . . 1 " 22,

and supposing Mr. Cubitt's proposal to be carried out, of placing caissons of 100 yards in length each,—the first would require a slope of 1 in 50, and the second of 1 in 15, but, of course, under the circumstances, of so abrupt a descent, an engineer would modify the length of his caissons accordingly.

**Tides.** The anchorage in six fathoms water is in the fair stream of tide, both on the flood and on the ebb, and the rate of the tide is about three knots on springs, and one and a half on neaps. We took advantage of a very calm day to set three buoys adrift at different distances from the shore, and found that, on the westerly or ebb-tide, there was no eddy even at one cable's length from the shore; but on the flood, or easterly going tide, an eddy is caused by Cheeseman's Head, which extends about a quarter of a mile from the beach in the bight of the bay.

**Shingle.** Except at the bar at the entrance of the harbour, the shingle in no case was found to extend below low-water mark, and in many places not so far.

In watching attentively the movement of the shingle on the beach, it appears to be impelled forward entirely by the action of the waves; the stream of tide, even in its greatest strength, has no influence on it, and as the prevalent wind is westerly, and that is also the point of greatest exposure, the greater part of the shingle travels from the westward; if therefore an opening were left between the shore and any pier or breakwater that might be placed hereabouts, the shingle would be forced in by the waves, and having no impulse to carry it forward it would remain and rapidly increase.

**Necessity of connecting the piers with the shore.** In like manner, if the eastern end were not connected with the shore in addition to some increase of shingle, the eddy on the flood-tide might tend to bring in at the opening, and deposit in the still water within, any silt or other matter which the tide-stream might hold in suspension.

The movement of the shingle then, and the set of the tides are both in favour of piers connected with the shore at each extremity of the harbour.

**Varne and Ridge.** With respect to the "diluvial matter from the Varne and Ridge being carried into Dover Bay," as stated in evidence before the Shipwreck Committee, it would hardly seem necessary to disprove so random an assertion; but as your instructions especially call my attention to this point, we visited the sands in question and got about a dozen casts of the lead, well armed, at different spots along the length of the shoal, the result is that the quality of the bottom differs considerably from that at Dover; at the Varne it is light-coloured coarse sand and large broken shells, while in Dover Bay the surface of the bottom is dark sand and mud with numerous worm-casts.

**Quality of bottom.** It may be added, that the general trending of the shoals is, as might be expected, directly with the fair stream of the main Channel tide which sets north-east; that Dover bears from the centre of the Varne north, eight miles distant, and that the Channel between them is from 18 to 20 fathoms in depth; moreover it is a well-known fact that the Boulogne fishermen, who sometimes leave their nets anchored on the Varne and Ridge, find them, if broken adrift by a gale, on the beach between Cape Grisnez and Calais, at a spot full 20 miles south-east of Dover Bay.

**Direction of shoals.** The space included within the lines of breakwater, as proposed by the Harbour Commission of 1840, is about 270 acres without the three fathoms line, or bare anchorage for 100 vessels; but should it be decided to make a harbour in this bay, nature seems to have pointed out a most favourable flat in seven fathoms water, forming a considerable sweep to the southward, on the outer edge of which it might be desirable to place the southern breakwater; the trending of this seven fathom edge towards the beach, as you advance to the eastward, also favours the carrying the eastern pier about one-third of a mile nearer the South Foreland, whereby double the area of excellent anchoring ground would be rendered available at but little additional expense.\*

**Area of harbour proposed in 1840.** Should such a proposal be carried out, the present harbour might be converted into a basin or floating docks by a caisson, or by lock-gates at the entrance, and the small stream which now falls into the harbour be turned out either to the eastward or to the westward of the breakwater.



It may serve, perhaps, as a useful point of comparison, with respect to dimensions, if I mention, in round numbers, the relative areas of a few roadsteads and harbours.

Report of  
Capt. *Washington*.  
Area of existing  
harbours.

Roadsteads.		Harbours.	
	Acres.		Acres.
Yarmouth Road . . .	8,000	Milford Haven . . .	1,000
Hollesley Bay . . .	3,000	Portsmouth . . .	200
The Great Nore . . .	4,000	Plymouth Hamoaze . .	400
Margate Road . . .	2,500	Sheerness . . .	1,500
The Downs . . .	7,000	Harwich . . .	700
The Little Downs . .	1,000	Dartmouth . . .	120
Dungeness East Bay .	3,000	Falmouth . . .	300
Spithead . . .	2,500	Kingstown . . .	180
Plymouth Sound . . .	800	Cove of Cork . . .	1,700
Cherbourg . . .	1,900	Ferrol . . .	1,700
Roche fort (Basque Roads)	16,000	Cadiz . . .	2,500
Brest . . .	7,500	Port Mahon . . .	400
Toulon . . .	800	Malta . . .	400

BEACHY HEAD AND EASTBOURNE BAY.

Beachy Head forms a bold promontory, offering good shelter in Eastbourne Bay from westerly gales. The apparent chief difficulty to contend with in making an asylum harbour here would be the sand lying immediately under Beachy Head, named Holywell Bank, or Sand-acre, which has at one spot only nine feet water on it at a distance of 600 yards from the shore. This bank materially tends, however, to prevent the weight of the sea setting home into the bay, so much so that I am assured by the officer of the Coast Guard, and by several fishermen residing here, that no instance is known of their being unable to beach their boats in Eastbourne Bay in a south-west gale; nor in the course of 12 years have more than three vessels grounded on this bank. In consequence of its position, any detached breakwater which it may be proposed to erect here must be carried as far to the eastward towards Langley Point as can be done consistently with securing a good entrance at the eastern as well as western end. The tides set fairly through the bay, both on flood and ebb, at the rate of two knots on springs and one on neaps.

Holywell Bank  
or Sand-acre.

Tides.

The shingle here comes chiefly from the westward, and with a south-west gale heaps up to the extent of several feet as far as the Beach Houses at Eastbourne; but it is going away at the Grand Redoubt, and to the eastward where the sea is gaining on the shore. A great fall of the cliff at Beachy Head, in November last, has stopped the progress of the shingle of late, and probably some groynes judiciously placed would arrest the encroachment of the sea on the eastern beach.

Shingle.

The distance from the shore to an anchorage in six fathoms low-water springs in the middle of the bay is rather more than one mile (2200 yards), and the water gradually shoalens to the beach; the bottom is of mud, sand, and shells, and is spoken of by all seafaring men here as good holding-ground off Eastbourne and Pevensey, but has foul ground without.

Anchorage.

The bearings of the headlands from the anchorage in six fathoms would be Hastings, east half north 10 miles; Beachy Head, west by south 3 miles; thus it will be seen that the roadstead is open for the whole southern board of the compass.

The Grand Redoubt and some Mortella towers might protect the in-shore part of the bay, but probably would not be sufficient protection for the outer part of the anchorage.

Defences.

One great objection, however, to bringing vessels in bad weather into this bay would be the rocky shoals, named the Royal Sovereign and the Horse of Willingdon; on one spot of the former, it is said, there are only 10 feet water, lying three miles and a-half south-east by east of the centre of the anchorage; but these, perhaps, might be well buoyed, or even the chalk rock blasted or cut away.

Shoals.

By way of comparing this with other localities, I may state that a breakwater in Eastbourne Bay two miles long, including cants at each end, constructed in seven fathoms at low-water springs, would enclose an area of 800 acres without the three fathom edge, and 900 acres without the two fathom edge, or sheltered anchorage for about 300 sail; but it would be difficult to place such an erection in any position in which a ship would not risk getting into very shoal water on entering or leaving by its eastern opening, or of getting entangled by the more dangerous rocky shoal of the Royal Sovereign, in the very possible event of missing the port when running for it in a south-west gale and thick weather.

Area.

NEWHAVEN AND SEAFORD ROAD.

The tidal harbour of Newhaven lies upon a nearly straight coast about eight miles to the westward of Beachy Head; the distance from the pier-heads into three fathoms water is 1000 yards, and to the six fathoms edge 1570 yards, or three-quarters of a mile; the general slope of the ground is 1 in 130.

Slope of bottom.

To the 1 fathom edge the slope is 1 in 180,			
„ 2	„	„	1 in 140,
„ 3	„	(at 1000 yards)	1 in 170,
„ 4	„	„	1 in 60,
„ 5	„	„	1 in 60,
„ 6	„	„	1 in 170,

at a distance of 1570 yards from the beach.

The bottom, off the harbour, consists of sand and broken shells and mud, over chalk, but has good holding-ground farther to the eastward throughout Seaford Bay.

The bearings of Seaford Head, from an anchorage in three fathoms water, would be south-east a quarter east, and it shuts in Beachy Head. Brighton Cliffs, the extreme western land, north-west a half west. From an anchorage in six fathoms water, Beachy Head, with the light just open, bears south-east about eight miles; Seaford Head, south-east a half east, two miles and a-half. Brighton Cliffs, the extreme western land, north-west a quarter west.

Bearings.

Thus the bay is entirely exposed from north-west round westerly to south-east, and well sheltered for the other half of the compass.



Report of Capt. <i>Washington</i> .	A breakwater in Seaford Bay one mile long, slightly curved to the southward, placed in six fathom water, and a pier of the same length nearly, run off in a south direction from Barrow Head, with an entrance at the south-west angle, would shelter, without the three fathoms edge, an area of 370 acres; and without the two fathoms edge a space of 470 acres, or anchorage for 180 vessels.
Breakwater.	
Newhaven.	At the entrance of the tidal harbour of Newhaven, I am told by the officer of the Coast Guard, and the pilots, that at low springs the shingle-bar now dries out to the Black Buoy, as laid down on the chart, or 50 yards from the pier-heads; but there are no other shifting sands or banks.
Shingle.	The shingle is not very great hereabouts, but is, as usual, brought up by a westerly gale, and forms a bar at the mouth of the harbour; a groyne is now being run out for the protection of the entrance to a distance of 100 yards from low-water mark.
Newhaven Har- bour valuable.	I must, however, state that the harbour seems to be of considerable value, and, owing to its powerful back-water, possesses facilities for further improvement; the piers should at once be widened, as at present there is only a width of 108 feet, and if they could be extended about 500 yards into 12 feet at low-water spring-tides, and the space within dredged gradually to that depth, Newhaven might afford, at no great expense, a valuable depôt for coaling and refitting steamers.
Seaford Road.	In Seaford Road, from position a very important place, the line of six fathoms water is in the fair set of the Channel tide, but within the three fathoms edge an eddy on the flood turns to the westward off Seaford Head, at one hour and three-quarters before high water by the shore, and is of great assistance to vessels making the harbour with a scant westerly wind.
Barrow Head.	In the possible event of a breakwater or pier being proposed in Seaford Road, I may mention that Barrow Head, a cliff of about 300 feet high just to the westward of the harbour, is of chalk, capped with a coarse sandstone, all of which might, perhaps, be available for forming a core or nucleus for such an erection; the lowering this headland would also much benefit the navigation of vessels entering and leaving the harbour, as with the wind to the westward it becalms their sails at the moment they require the whole of their headway to shoot out or in between narrow piers, with a tide running directly across them.
Brake Sand.	This, Sir, I trust completely replies to your instructions, to which I am much indebted for suggesting many points that otherwise might have escaped my attention.
Has moved to the westward.	As the subject of the extraordinary change of position in the Brake Sand, off Ramsgate, has been much discussed, I felt it my duty to examine it, as far as my limited time would allow me, and for this purpose obtained from Captain Beaufort, hydrographer to the Admiralty, the original drawing of the survey of the Downs by Græme Spence in 1795, and that of Mr. Thomas, R.N., in 1832; and on these original documents, and on their own points, I laid down the angles that we observed in April, 1844, all which prove, as I had fully anticipated, that Captain Bullock's recent chart of this sand is perfectly correct as to its position; that the Brake Sand has gradually moved bodily to the westward, the four fathoms edge having, in 1832, moved about 500 yards, and in 1844 as much as 100 yards more, making a total move of 600 yards in the space of 50 years; perhaps, considering its position, one of the most remarkable changes of a body of sand on record; but in spite of these changes, I see no reason why the Brake should not be fixed by a skilful engineer in its present position, and thus converted from an evil into a benefit.

To Admiral Sir T. Byam Martin, G.C.B.  
*§c. §c. §c.*

I am, Sir,  
 Your obedient servant,  
 JOHN WASHINGTON, *Captain.*

Report on Dun-  
 geness.

## REPORT OF CAPTAIN WASHINGTON ON DUNGENESS AND FOLKSTONE.

*H. M. S. Blazer, Dover Bay, May 13, 1844.*

Chart.	Dungeness forms a remarkable shingle point, projecting in a south-south-east direction four miles beyond the fair line of the coast, making a natural breakwater of low land, affording shelter in the east bay from north round westerly to south-west by west; and in the west bay from north round easterly to east, or for 19 points of the compass.
Small change in the East Bay.	Dungeness East and West Bays have been thoroughly sounded during the past week to a general distance of three miles off shore; and the depth of water, quality of bottom, set of tides and eddy, are shown in the accompanying chart on the scale of $1\frac{1}{4}$ inches to a mile, nearly, by Lieut. Cudlip and Mr. E. K. Calver, master, assistant-surveyors of Her Majesty's ship under my command.
West Bay.	On comparing this examination with the Admiralty published chart of this locality of 1809, it appears that during the past 35 years the general soundings have altered but little; in the East Bay, immediately to the eastward of the Ness, the four fathoms edge of the "Roar Bank" has grown out about a quarter of a mile, but to the eastward of the "Roar Spit, or Newcome Buoy," it returns to the old line, which it pursues as far as 10 miles from the Ness, when it trends sharply half a mile in shore towards Hythe, and thus continues till it falls into the rocky beach at Folkestone; its average extent to the four fathoms edge is a mile and a half from the beach at Dymchurch.
Swallow Bank.	In the West Bay the four fathoms edge has gradually inclined in-shore till off Rye, at five miles from the Ness, where the flat has decreased fully half a mile.
Chapel Bank.	The great change, however, is in the two shoals of "Swallow Bank," three miles to the eastward, and "Stephenson's" or "Chapel Bank," three miles and a half to the westward of the Ness; Swallow Bank has decreased from a mile to half a mile in extent within the four-fathom edge; and Stephenson's Bank from two miles to only one mile long, and narrowed to a quarter of a mile; while the depth of water on the former has increased from 16 to 22 feet at low-water springs.
Tides.	These changes appear so material, without any visible cause, that it is right to state that possibly the survey of 1809 was only cursory, having been made during the common course of service in war time.
Quality of the bottom.	The rise of tide at Dungeness is 22 feet on springs, and 13 on neaps, being the largest rise along this coast. The tide-stream, both on flood and ebb, sets past the Ness and fairly through the bay along the seven fathoms edge, at the rate of two miles and a half an hour on springs, and one mile and a half on neaps, gradually decreasing to half this strength as you approach the shore into the three fathoms edge.

The quality of the bottom in both bays is fine sand over clay and mud, and excellent holding-ground



throughout; and I am told by the pilot, that in westerly gales he has seen 300 vessels at anchor well sheltered in the East Bay.

From all the information I can gain, the shingle on this beach, as elsewhere, is moved to the eastward or westward according to the gales of wind, and as the prevalent winds are westerly the chief movement of the shingle is from the westward; from careful measurements it appears that the distance from the centre of the lighthouse to the nearest point of low-water mark at spring-tides is 190 yards, to the Eastern Ness 400 yards, and to the Western 433 yards. Now, a valuable inscription inside the lighthouse records that the present building was erected in 1792, at 100 yards from the sea, consequently the beach has grown out a direct distance of 90 yards in 52 years, or about five feet a-year; the Eastern Ness has in the same period increased 50 yards, and the Western 100 yards in extent, judging from the Admiralty chart by Græme Spence.

From the top of the lighthouse the view extends over a waste of shingle covering an extent of about six square miles; it is furrowed throughout as the waves of the sea, giving the idea that each ridge marks the period of a very heavy south-west gale of wind. The width between these ridges varies materially, but they average about 20 yards apart.

Perhaps I may be permitted to say that I was most forcibly struck with the perfect order of the light apparatus and everything connected with this establishment; the recent alterations have added materially to the efficiency and comfort of the lighthouse, and the perfect cleanliness of the reflectors and every part of the building, and the comforts provided for the lightkeepers, even to books furnished to their library evince the paternal care of the corporation under which the lighthouses are placed.

On the chart I have, for the sake of comparison, projected in pencil in Dungeness East Bay a breakwater, with its western edge resting on the Swallow Bank, and extending in seven fathoms water two miles in a north-east direction; such a breakwater would enclose an area of 800 acres between the three and the seven fathoms edge, and would give an entrance at each end a quarter of a mile wide, and accessible in all winds and at all times of tide, by night as well as by day.

This space would enclose the "Swallow Bank;" but as it would lie close to the south-western pier-head, it is probable that the action of the tide would scour it away to the general depth of five or six fathoms; this, however, is but conjecture, and as the southern kant of the breakwater, in order to obtain shelter from south-westerly gales, must in some measure curve across the set of the tide, it may also be conjectured that a deposit of silt will take place within.

From an anchorage in six fathoms, about the centre of this space, the following bearings were taken:—

Dungeness, extreme point, south-west by west. Folkestone, east-north-east.

Dover Castle and South Foreland, east by north half north.

The nearest point of land at New Romney, north-west, distant one mile and three-quarters; two-thirds of which space is over a flat of less than three fathoms water.

The slope of the bottom, in the line of proposed breakwater, would be but slight; it would follow generally the seven fathoms edge.

Any shore defences in this bay, from their distance, would not be available for the protection of an asylum harbour; a breakwater, if erected, must defend itself.

It is said that there is a good supply of fresh water in the tank near the beach in the East Bay, brought by pipes from the interior of the country. The only well we visited had three feet of water in it, and its whole depth was 15 feet; this, however, was at the close of a dry season.

#### FOLKSTONE.

Folkstone has a tidal harbour of 14 acres area, with a dry shingle-bar. The shore abreast is rocky to the extent of half a mile distance, when it drops rather suddenly into eight and ten fathoms water. The harbour has lately been much improved, and a groyne is now being run out from the western pier into eight feet at low water, in order to endeavour to arrest for a few years the progress of the shingle, which here, as elsewhere, advances chiefly from the westward.

I have, &c.

JOHN WASHINGTON, *Captain.*

To Admiral Sir T. Byam Martin, G.C.B.

#### INSTRUCTIONS FOR CAPTAIN WASHINGTON.

SIR,

Harwich, June 5, 1844.

THE conflicting evidence we have had before us, respecting the anchorage in Dover Bay makes it indispensably necessary to have recourse to every means of testing its quality as a holding-ground.

I have therefore to request, on the part of the "Harbour Commission," that you will proceed in the *Blazer* to Dover, in order to try how far the holding-ground is trust-worthy, in the event of the bay being converted into a close harbour for the reception of a fleet of war steamers, and as a harbour of refuge for commercial vessels.

It occurs to me that it may be an effectual way of proving the quality of the bottom if you anchor the ship in six or seven fathoms at low-water spring-tides, and after veering out to the length of cable you would think sufficient to hold her in a heavy gale of wind (perhaps a whole cable, and afterwards a half, or less), then to back the ship by the paddles; and when the cable indicates that the first power of the paddles is felt, to drop the lead over the side, and watch if the anchor starts in consequence of the dragging power applied to the paddles.

The great length of sea practice you have had in the *Blazer* and experience of the power of her engines, will enable you to judge with near accuracy of the rate at which the ship would be going (at the time when the anchor starts) if under way, and thus to form a fair opinion of the quality of the anchoring-ground.

This appears to me the most satisfactory way we can have of trying how far the ground is to be relied upon, and I am sure the members of the Commission will feel, as I do, the utmost confidence in committing to your hands so important an experiment.

You will of course bear in mind that the experiment supposes a ship to be within a close harbour at Dover, where there will be but little if any tide to add to the strain on the cable, or any lifting sea to trip the anchor; the trial ought therefore to be made at a time of slack and smooth water.

Report of  
Capt. Washington.

Movement of the  
shingle.

Increase of beach.

Perfect state of the  
lighthouse.

Area of a projected  
asylum harbour.

Breakwater.

Bearings of land.

Slope of bottom.

Defences.

Water.

FOLKSTONE.

Instructions for  
Capt. Washington.



Instructions for  
Capt. Washington.

The experiments may be repeated in different parts of the bay, and varied in any manner you may think best calculated to lead to a right conclusion.

It seems desirable that Mr. Iron, an intelligent and experienced seaman, the harbour-master at Dover, ought to be present on the occasion, and join with your able first-lieutenant and master in reporting to you their observations during the experiments.

Ships coming to an anchor generally "round to" to stop their way before the anchor is let go; but in order to test the Dover ground still more severely, you can run in and anchor when the ship is going on at the rate of two or three knots, to see if with this sudden jerk she brings up without dragging more than must unavoidably be the case until the anchor has taken fair hold of the ground.

Having performed this service, it is desirable that the "*Blazer*" should proceed to Woolwich for two or three days, previously to her being released from further employment by the Commission.

It may be proper to read this letter to your officers, and to Mr. Iron.

I send herewith a letter to Mr. Iron, to request he will attend on board the *Blazer* at any time you may propose.

I am, Sir,

Your very humble servant,

T. BYAM MARTIN.

To Captain Washington,  
Her Majesty's Ship "*Blazer*."

P.S.—The only object in desiring to have the *Blazer* at Woolwich is to examine the master, if necessary, about Dover; you can therefore send the ship to such place as may be best for the convenience of the public service, so that the master may be within reach.

T. B. M.

Report of  
Capt. Washington.

## REPORT OF CAPTAIN WASHINGTON ON THE HOLDING-GROUND IN DOVER BAY.

Her Majesty's Ship, "*Blazer*," Dover Bay,  
10th June, 1844.

SIR,

IN compliance with your directions I have the honour to report our arrival in Dover Bay yesterday morning, and having embarked, Mr. Iron, harbour-master, and Captain Russell Manners, R.N., who has been in the habit of paying long visits at Dover during the last few years, we immediately proceeded to carry out the experiments proposed in your detailed instructions, in order to test rigorously the holding qualities of the anchorage in Dover Bay, within the limits of the projected breakwater.

*First trial.* In the western part of the bay in five fathoms water:—

Let go the anchor, going before the tide at the rate of three knots over the ground; brought the ship up suddenly with half a cable, and found by two fixed objects on shore in line, that she held fast. On heaving up, brought up chalk on the flue of the anchor.

*Second trial.* One quarter of a mile farther to the eastward, in three and a half fathoms water:—

Let go the anchor, running before the tide at the rate of three knots over the ground; brought the ship up short, with 36 fathoms of cable, and found she held fast. Backed astern, with the whole power of the engine, without starting the anchor. On heaving it up, brought up chalky clay.

*Third trial.* A quarter of a mile farther to the eastward, in five and a half fathoms water:—

Let go the anchor, running before the tide at the rate of four knots over the ground; veered to 36 fathoms of cable; carried away the lariards of the stoppers, and dragged a ship's length before she brought up. On swinging head to wind, backed astern, with the whole power of the engines, without starting. On heaving up the anchor, brought up chalky clay.

*Fourth trial.* At the extreme eastern limit of the breakwater, nearly under the Cornhill station:—

Let go the anchor, running before the tide, with only 36 fathoms of cable; rate over the ground four knots: dragged about a ship's length, when the anchor held, tearing the cable through the stoppers, and carrying away the new three-inch lariards, passed with racking turns, when she brought up and swung to the tide. Backed astern at full speed without starting the anchor. On heaving up, found the anchor had buried itself to the crown in soft chalk.

*Fifth trial.* Returning to the westward, half a mile farther off shore, in seven fathoms water:—

Let go the anchor, running before the tide, with 40 fathoms of cable; rate over the ground three knots: ship brought up and held fast; backed the paddles at full speed, when she drove about a ship's length. On heaving up, found the iron stock of the anchor, by which the ship had evidently been riding, carried away in the wake of the fore-lock, but no symptom of a flaw in the work.

*Sixth trial.* At half a mile farther west, in seven fathoms of water:—

Let go the anchor, running before the tide at the rate of four knots over the ground; dragged the cable through the stoppers, and when the whole strain came on, parted the cable at about 30 fathoms from the anchor. Anchored for the night with the best bower. In the morning, having picked up our anchor and re-shackled the chain, we continued our experiments on the holding-ground in the bay.

*Seventh trial.* A little west of the Castle Jetty, in seven fathoms water:—

Let go the anchor, running before the tide at the rate of three knots over the ground; run out 36 fathoms of cable, when the ship brought up short, and sallied astern some distance; when she swung head to tide, backed the engines at full speed, without starting the anchor. On heaving up, found that the whole arm of the anchor, up to the crown, had buried itself in soft chalk.

*Eighth trial.* Just off the harbour's mouth, in seven fathoms water:—

Let go the anchor, running before the tide at the rate of three knots over the ground; run out 36 fathoms of cable, when the ship brought up short, and sallied astern half a ship's length. On heaving up, found that the flue of the anchor had searched deep into chalky clay.

The weight of the anchors with which the above experiments were made was 18 cwt., including the stock; diameter of chain  $1\frac{1}{8}$  inches, equal to a 14-inch hempen-cable, the mean breaking-strain of which is 36 tons. The burthen of the *Blazer* is 540 tons.

In all these experiments I purposely veered to less than half a cable, in order to make the trials, under conditions, as similar as possible to those of a ship bringing up in a crowded harbour. On



carefully examining the chain after the trials, several links were found bent, thereby proving the unusual strain brought on the cable.

From inquiry of Lloyds' agent and others, at Dover, I find that during the late heavy east and north-east gales, upwards of 100 vessels rode them out at anchor in Dover Bay; among them the American ship "Lucas," of 346 tons, riding with two anchors down, parted her best bower cable on the 20th May, and on heaving up her small bower, found one fluke broken off. In the same gales, on the 25th May, the bark "Archibald," of Memel, of 300 tons, parted her best bower cable, and brought up with her small bower.

Thus the tough nature of the holding-ground, so much better than from common report I had anticipated, having disabled one anchor and parted the cable from the other, and the fact of two large ships having also parted their cables in the recent gales, appear to me decisive as to the good quality of the anchorage, nor, after the trials I have witnessed, should I have any hesitation in riding out a gale of wind in Dover Bay in its present state; how much less so when enclosed by a breakwater.

I am, Sir,

Your obedient servant,

JOHN WASHINGTON, *Captain.*

To Admiral Sir Byam Martin, G.C.B.,  
*&c. &c. &c.*

P.S. I have read this report to Mr. Wingrove, first lieutenant, and Mr. Calver, master of the *Blazer*, as well as to Captain Manners, R.N., and Mr. Iron, harbour-master, at Dover, and they entirely concur in the statements contained in it.

Report of  
 Capt. Washington.

#### INSTRUCTIONS FOR COMMANDER SHERINGHAM, R.N.

*Harbour Commission, Gwydyr House,  
 May 10, 1844.*

Instructions for  
 Com. Sheringham.

SIR,

THE Lords Commissioners of the Admiralty having signified to the Harbour Commissioners that you have received directions to attend to such duties as may be pointed out to you by the Commission, I have, on the part of the Commission, to request that you will proceed in Her Majesty's ship under your command to Portland and Weymouth Roads, and there enter upon a detailed examination of those anchorages, sounding pretty closely as far out as the seven fathom line, and more openly to the 12 fathom edge, and laying them down on a chart on a scale of about six inches to a nautic mile.

As upon such short notice it is probable you may not be able to obtain an extended scheme of points over this district from the Board of Ordnance, it will be sufficient for the purpose of the Commission if you take the points from the last published Ordnance survey, or, for want of a better, from that of Mackenzie, of 1737, marking in it any material changes in the coast line which may have taken place.

The material objects in thus employing Her Majesty's ship under your command may be stated as follows, viz.—

1. To enable you to ascertain, with the utmost accuracy, any change which may have taken place in the depth of water since the publication of the last Admiralty chart, or any charts of known good authority; and to mark in the chart you will deliver to the Commissioners the former and the present lines of any shoals, specifying the dates of those charts with which these comparisons may be made.

2. To observe the set and strength of the tide along shore from the Bill of Portland to White Cliff and Lulworth, both in the bay and in the offing; and to observe yourself and gain all the information you can from pilots and sea-faring men, as to the effect of the small river Wey, or any other stream that is likely to cause a deposit in the bay.

3. To describe the quality of the bottom carefully through both anchorages; also to note the movement of the shingle along the shore, and if what is brought in by the wind from one quarter appears to be carried off to sea, or carried back by any change of wind.

4. To anchor your ship on the six fathoms line at low-water springs, and when in that position to state the distance from the shore, and the bearings of the most prominent points and headlands.

5. To ascertain, by very careful sounding, any change the bottom may have along the six fathom line, that an opinion may be formed whether it has a convenient flatness, or otherwise, for the reception of long caissons in forming a breakwater, should such an erection be proposed.

6. To collect any information bearing in any way upon the objects pointed out to your attention, and to make such observations, respecting Portland and Weymouth Roads, as may enable you to answer any questions which may be put to you by the Commission.

You will occupy yourself in this business until the arrival of the Commission in Weymouth Roads.

I am, Sir,

Your obedient servant,

(Signed) T. BYAM MARTIN.

To Commander Sheringham,  
*Her Majesty's Ship, Fearless.*

#### REPORT OF COMMANDER SHERINGHAM.

Report of  
 Com. Sheringham.

*Her Majesty's Steam Surveying Vessel, Fearless,  
 Weymouth, 26th May, 1844.*

SIR,

I HAVE the honour to acquaint you that I have, in compliance with your directions on the part of the Harbour Commissioners, completed, with all the detail that the time would admit of, a survey of Portland and Weymouth Roads, on a scale of six inches to the nautic mile.

In order to insure the utmost accuracy in this examination, it was scarcely advisable to trust to an enlarged scale of Mackenzie's survey, and I therefore constructed a scheme of points on my own triangulation.

As the time would not permit me to lay down the whole of the coast line from my own observations, I have supplied the deficiency from the above authority, and have great pleasure in bearing testimony to that accomplished surveyor's general accuracy.

The Commissioners having drawn my attention to the necessity of marking any changes which have taken place in the depth of water since the publication of the last Admiralty survey, I have, in compliance therewith, carefully compared the two, and was much gratified to find, that with very few



Report of  
Com. *Sheringham*.

exceptions, an extraordinary agreement existed ; and for the satisfaction of the Commissioners I have here and there introduced upon my plan, in red, the depths transferred from the old survey.

It is to be regretted that the adverse state of the weather during the only period of spring tides that I have been here would not permit me to make those elaborate observations on their set and velocity which it would have been desirable to have done. I have not failed, however, to make diligent inquiries upon this important head, and verified the information thus obtained by personal observation at every opportunity.

I find, by actual observation, that the vertical rise of the tide at Weymouth Pier is inconsiderable, our register showing only five feet seven inches at springs, and three feet at neaps ; it must be observed, however, that the late prevalence of strong north-easterly winds have considerably assisted in cutting the tides during the last lunation, but I am fully assured that seven feet may be considered as a fair spring rise.

With respect to the set of the tidal stream, it would appear that the main or Channel ebb, after passing St. Alban's Head, runs in a line parallel to the shore, until within a short distance of Whitenore Point, from whence it bends rather abruptly towards the Shambles.

To the northward of Whitenore, the ebb feeds further into the bay, but passes out again round Grove Point ; and thus, as the head of the bay is approached, does the ebb form a succession of curves, taking the shape of the bay, gradually merging into each other, between North End and Grove Point, with accumulating velocity ; until, at the latter position, it becomes, at springs, a perfect race.

The tide from Weymouth Harbour, when free from the influence of the piers, bends to the westward, takes the round of Portland Bay, and ultimately runs along the east shore of Portland, as before.

The main flood is deflected by the Shambles, and sets towards St. Alban's Head ; but there is a considerable portion of it which runs within that shoal, and sets smartly round Grove Point, bending into the bay, and then across to Whitenore Point.

To the northward of Fern Hill, its velocity is very inconsiderable ; indeed, within a line drawn from North End to Mill Cove, on the north-east shore, it has been well expressed by Mackenzie, that the tides are scarcely sensible. The set of the tides, when obtained by our own observations, have been inserted upon the plan, the red indicating an ebb, and blue the flood.

I have every reason to believe, from a close examination of the nature of the bottom at the entrance of the little river Wey, that no deposit takes place ; and, from the remarkable clearness of the water in the roads, nothing of importance is carried out, although the line of the tide is distinctly to be traced by a slight discolouration indicating that some substance is held in suspension on a reflux tide.

It is at all times difficult to convey an accurate description of the bottom by what is brought up by the ordinary arming of the lead ; but, as I am desirous that the Commissioners should be able to form as correct an opinion on that head as possible, I have deemed it expedient to preserve specimens of the surface for their inspection. I have reason to believe, however, not only from report, but from what has been brought up on our anchors, that the sand and gravel is merely a thin covering to a stiff blue clay, a specimen of which is also preserved.

Under this head I may observe that the general character of the bottom is perfectly clean or free from rock.

With respect to the travelling of the shingle, I have not been able to gain any very certain and satisfactory information. Doubtless, however, considerable quantities are occasionally thrown in by southerly gales. The principal deposit seems to be near the junction of the rising ground on the north-east shore with the low flat at the east end of the esplanade.

With the exception of that extraordinary ridge, the Chesil Beach, I see no deposit of consequence in any other part of either bays.

Agreeably with your directions, I anchored the ship on the six-fathom edge, selecting what I considered the most eligible part of it, and from thence took bearings of the principal head-lands, as follows ; viz.—

Whitenore Point	. . . . .	East.
St. Alban's Head	. . . . .	South-east by east, half east.
Grove Point	. . . . .	South, quarter west.

Distant from the nearest shore two-thirds of a mile.

As an opinion prevails that, from the declivity of the bank, ships are very apt to drive in north-west gales, I have calculated the slope from the four to the thirteen-fathom edge, in about a north-north-west and south-south-east direction, which direction would probably cross the line of a breakwater at nearly right angles. The descent averages about three feet in a thousand. A section of the above slope is introduced upon the plan.

A quarter of a mile south of North End, or about midway between King's Pier and the Point, a line run out in a north-east a quarter north direction, seems to lead over a convenient flatness for the site of a breakwater, should such a proposition be entertained. For the first quarter of a mile the dip is very sudden, falling as it does, at that distance from the shore, into eight fathoms ; but, from thence to the outer end, there are very few feet variation.

In conclusion, having, I trust, directed my attention to the several heads contained in your instructions, and informed myself on the subject as well as so short a time would allow me, I would request the indulgence of the Commission for not laying before them a more finished drawing, not having had an opportunity to make a copy of my working rough.

I have the honour to be, Sir,

Your most obedient servant,

*Sir T. Byam Martin, G.C.B.,*  
*&c. &c. &c.*

W. L. SHERINGHAM, *Commander.*

Report of  
Lt.-Col. *Jones*, R.E.

## REPORT OF LIEUT.-COLONEL HARRY JONES, R.E., ON THE BEST SLOPES FOR BREAKWATERS.

*Shannon Commission, Custom-House, Dublin,*  
*June 1, 1844.*

SIR,

THE principle which generally has been adopted of employing long sea slopes for breakwaters in deep water having for some years occupied my attention, I beg leave to bring under the Com-



missioners' notice, in a condensed form, the substance of a communication which I made some years past to the Institution of Civil Engineers; the importance of the subject in an economical point of view, will, I am confident, ensure for it that consideration which it deserves.

Report of  
Lt.-Col. Jones, R.E.

As one of the Commissioners for the improvement of the navigation of the river Shannon, my attention was directed to the best form to be given to the extension of Kilrush Pier, near the mouth of the river, and exposed to the direct action of the sea rolling in from the Atlantic in westerly gales, and calculating the time and expense to build the pier with a sea slope, as the Commissioners considered best in the first instance; and having had the advantage, before the work was commenced, of witnessing the effects of several severe storms upon Kingstown, Howth, and Dunmore harbours, each constructed with a long sea slope, having different angles of inclination, where all of these works suffered considerably from the effects of the sea breaking upon the long sea slope between high and low-water mark; the circumstances above mentioned, coupled with the previous knowledge of what had occurred at Cherbourg and Plymouth, induced me to pay more particular attention to the subject. I then visited Cherbourg, Granville, St. Malo, and other ports; at all these I found the upright section had been adopted, at the former the upright wall was building upon the *pierre perdue* in the form as shown on the tracing which accompanies this letter, marked A. About this period I had the advantage of making acquaintance with an American engineer, and who, when conversing upon the subject of the breakwater in Delaware Bay, informed me that in the United States they did not approve of the long slope.

I therefore strongly recommended to my brother Commissioners to alter the section for Kilrush from the long slope to the upright wall; this they consented to do, and the work has been executed according to the section marked B, coloured red. The section coloured yellow is the section as originally proposed.

The Commissioners will, at a glance, perceive the great saving as regards material, and consequently great economy in the time of the construction of the pier which has long since been completed, and which could not have been effected with the long slope in the same period.

I have not entered into the details of construction, because they must vary according to localities and materials to be used; at the same time I wish the Commissioners distinctly to understand that the principle I advocate is to present as *perpendicular* a face as possible to the action of the sea; and if expense was not a consideration, an upright wall founded on the bottom of the sea would, in my opinion, be the most desirable and preferable mode of construction.

The accompanying drawings show the sections of Cherbourg, Kingstown, and Kilrush; the first is accompanied with some written details of the construction of the new breakwater, and which appears to answer perfectly. There cannot be a doubt but that if the French engineers, with their present experience, had to construct another breakwater with *pierre perdue*, they would not form such a long foreshore; there is no necessity for it, as by observation it is ascertained that below the line of low water no disturbance takes place, therefore the more perpendicular it is built, the less cost in labour and materials.

A.

B.

C.

Kingstown still remains as insecure as heretofore; the enormous mass of stone placed on the outward slope at the line of low water is greatly acted upon with almost every easterly gale, and certain portions of the loading are washed away; even with the long slope which this pier possesses; the waves, in very heavy gales of wind, run over the apex, and, falling down, have repeatedly disturbed the surface of the roadway on the inner side. It is very interesting to watch the action of the sea upon the recently finished circular head of the eastern arm, and at the same time upon the long slope, where the two descriptions of work unite; against the former the sea rises and falls without violence; whereas on the long slope the sea breaks and falls upon it with great fury. Take the section of Plymouth, Kingstown, or Cherbourg, and ask any engineer if he considers such a mass of material, if properly disposed, necessary to resist the action of the sea, and he must, I conceive, say no. The great consumption of time, labour, and materials at Plymouth breakwater has been principally caused by the great base which was originally marked by buoys, within which the stone vessels were to discharge their cargoes; had the construction of the work been with a view of making the sea face as nearly vertical as possible, what a difference there would have been in the progress of the work, and in the amount expended! The angle which stones form when wheeled out from a quarry, or forming the head of an embankment, will be about  $60^{\circ}$  or  $70^{\circ}$ ; and such, it may be presumed, would be the same with stones dropped into the sea with the intention of taking as perpendicular a form as the nature of the material will permit. Acting upon a narrow base, the mass would soon attain the height of low water, and this once accomplished, there would immediately be found quiet water on its inner side. The French at Algiers re-constructed the Mole with an upright wall, formed with blocks of beton in 30 feet water, which has stood remarkably well. The numerous examples of upright sea walls clearly demonstrate that they do and will resist the violent action of the sea if properly built.

In the Report of Mr. William Stuart, addressed to Rear-Admiral Warren, dated 27th February, 1838, it is stated, "The quantity of rough stones which have been thrown over from the foreshore to the northside along the *whole line of the finished work* amount to about 9,000 tons!

The more perpendicular the face of the work, the greater weight has a wave to lift, consequently the work is so much the stronger; in fact, against an upright wall the wave never breaks, provided there is deep water in front of it; in the case of seven fathoms, it may be presumed that, with such a depth, the waves would only rise and fall against the upright face.

The section, as proposed by me, is represented on a section of Kingstown Harbour, the *pierre perdue* of the outward face is drawn at an angle of  $50^{\circ}$ , (if it could be formed more perpendicular, so much the better,) the upright wall is to be founded as much below low water as possible; and this, in fine weather, can easily be effected at 2 feet 6 inches or 3 feet below that line; the *pierre perdue*, on the inner side, is laid down at an angle of  $60^{\circ}$ ; at the same time it would be desirable to build a considerable portion of the inner face perpendicular with a diving-bell, so as to form a quay or wharf where line-of-battle ships could lie alongside, take in stores, &c. The advantages to be derived from such accommodation must be apparent to all professional men.

D.

In forming the base with *pierre perdue*, I would frequently throw in amongst the rubble, mortar made with hydraulic lime, this would cement the work into considerable masses, and thus form a solid compact body, which is particularly desirable.

In forming the lower portion with *pierre perdue* the operation should be confined to as narrow a base as possible, in order that the mass may raise its head as soon as possible above low water; this



Report of  
Lt.-Col. Jones, R.E.

once effected, protection is obtained for vessels riding inside, and if a gale should disturb or wash down some of the work, it only disturbs a portion, and throws the material into a favourable position as regards the future progress of the work: compare the short period within which this can be performed with the length of time required to raise the mass upon the more extended base of a breakwater formed with a long sea slope above the level of low water, as at Plymouth or Kingstown.

Sections of Kilrush Pier are given, which show what was originally proposed, and what has been executed. The Commissioners have reason to congratulate themselves upon the change, as it would not have been possible to have attained within the same period the same extent of work and protection. The section, as executed, is greater than the old work, which, however, stood remarkably well. In forming the foundation, the work was performed by the diving-bell, with large flat-bedded stone set on edge; this description of work is quickly performed; and if there happens to be a soft spot, a few of them may sink a little by their own weight, and the superincumbent mass will not be affected by it, as the ashlar work may be regarded as resting upon as many points as there are stones on edge under it.

Should the Commissioners be desirous of having any further details, it will afford me great pleasure in attending to their wishes.

I have the honour to be, Sir,

Your obedient servant,

HARRY D. JONES,

Lieut.-Colonel Royal Engineers.

To the Secretary,  
Commission for Harbours of Refuge.

Report of  
Mr. Stuart.

#### REPORT OF MR. STUART ON PLYMOUTH BREAKWATER.

(Referred to in the preceding letter.)

SIR,

Plymouth, February 27, 1838.

AFTER you left me at the breakwater yesterday morning, I waited until low water, when I was enabled to take a full survey, and take measurements of the damages done to the breakwater by the heavy seas and high tides of Saturday night and Sunday morning last, and therefore now beg leave to give you a detailed report of them.

The quantity of rough stones which have been thrown over from the foreshore to the north side, along the whole line of the finished work, amounts to about 9000 tons, of which there are about 1000 tons only in the whole length of the finished work, to within 250 feet of the foundation of the lighthouse, and in that space the remaining quantity of about 8000 tons is now lying; the reason of so much being thrown over at that place is, from its lying directly inside the Nap and Panther shoals, on which the sea constantly rises to a very great height, and comes unbroken directly on that part of the breakwater; indeed it is these seas which always cause so much damage in the Sound. The stone, some of them from seven to nine tons in weight, coming in constant succession, and with such tremendous force in contact with the masonry (at that part where the toe of the south slope is unfinished), broke and loosened it; and the sea having once obtained an entrance, about 23 yards in length and five yards up the slope have been swept away, and about 33 yards shaken. There has been a settlement of the work for about 100 feet in length, where the work is only cased with dressed stone, and a few stones in the middle of the south slope have been thrown out, which I attribute to the air getting between the interstices in the rubble work, being violently compressed by the lift of the sea, and thereby forcing them out. I am happy to state that no part of the solid masonry around the foundation of the lighthouse has been injured, not even a joint opened, as far as can be seen. The injury at the east end is so trifling that it is not worth mentioning, the south slope having only settled down a little.

As far as my own observation goes, and which is confirmed by the opinion of others, the sea was much heavier than during the gale of 1824; and as a proof of it, the stones placed upon the top of the work at the east end for the protection of the jetty, and which have been there for twelve years bedded in cement, and bound down with iron cramps, have been torn up and thrown over on the north side of the work; and also the masonry at the west end built for a similar purpose, has been completely swept away.

I shall without delay proceed to erect a crane to replace the stones, and commence throwing very large stones in front of the foreshore, where the breach has been made, and which, in my opinion must be our chief protection at that part of the work.

I am, Sir,

Your obedient servant,

WILLIAM STUART.

To Rear-Admiral Warren.

Report of  
Capt. Washington.

#### REPORT OF CAPTAIN WASHINGTON ON THE MEMORIAL OF THE MAYOR AND CORPORATION OF THE BOROUGH OF HARWICH.

Woolwich, January 19, 1843.

Harwich a port of  
refuge.

THE port of Harwich, owing to its general depth of water, its extent, the shelter it affords, and its immediate communication with the sea, is one of the most valuable on our eastern shores; and although the rivers Thames and Humber afford shelter by running far up them, yet Harwich, from its easy access by night or by day, in all weathers, and in all states of the tide, is the only harbour of refuge, properly so called, on the East coast of England.

Memorial of mayor.

The memorial of the Mayor and other inhabitants of the borough of Harwich states, that in this harbour, which in easterly gales has given shelter to 500 sail of shipping at once, great changes have taken place within the last 20 years, owing to the falling down and washing away of Beacon Cliff on the western side of the entrance, and the growing out of Landguard Point on the eastern side, whereby the harbour is already much deteriorated, and is daily becoming worse.

To the truth of this statement I can bear the fullest testimony from my own observations during the last two years, and all the evidence I can obtain, goes to show that the sole and immediate cause of the damage in question is, the digging up and carrying away the cement stone from the foot of Beacon Cliff, and Felixstow Ledge.



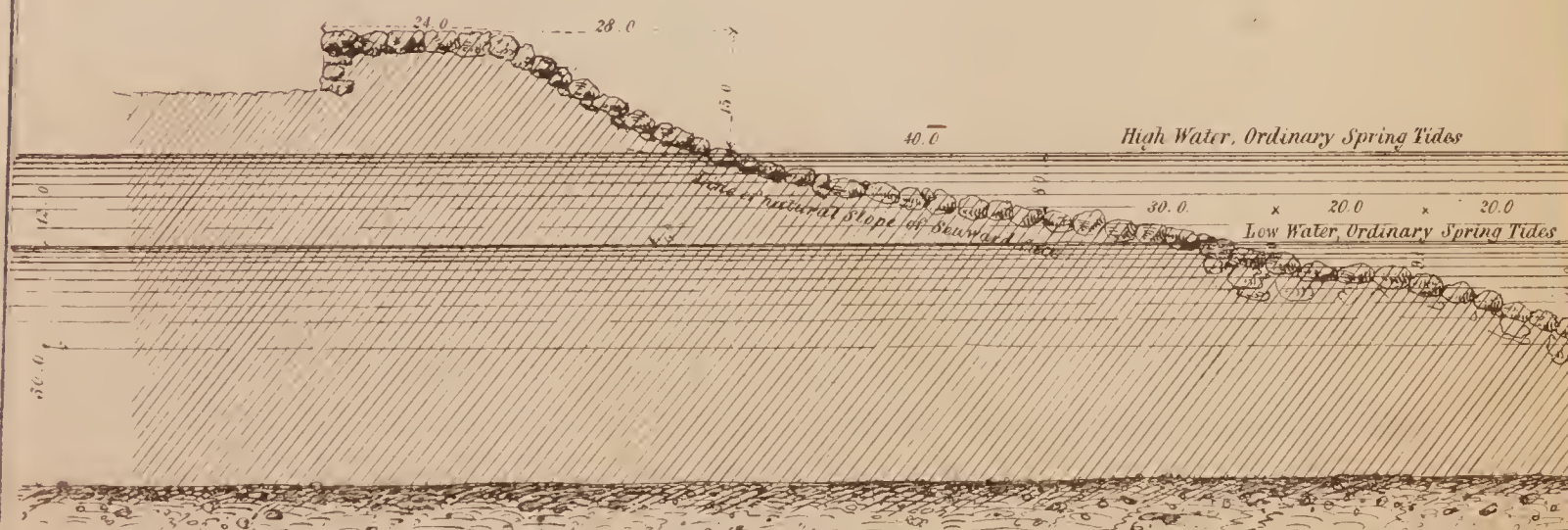
# PROFILE OF THE BREAKWATER AT CHERBOURG IN PROGRESS.

Illustrative of L<sup>t</sup> Col. Harry Jones's Letter, dated June 1<sup>st</sup> 1844

## SECTION A.



## SECTION THROUGH THE EASTERN ARM OF KINGSTOWN HARBOUR C.



# KILRUSH PIER.

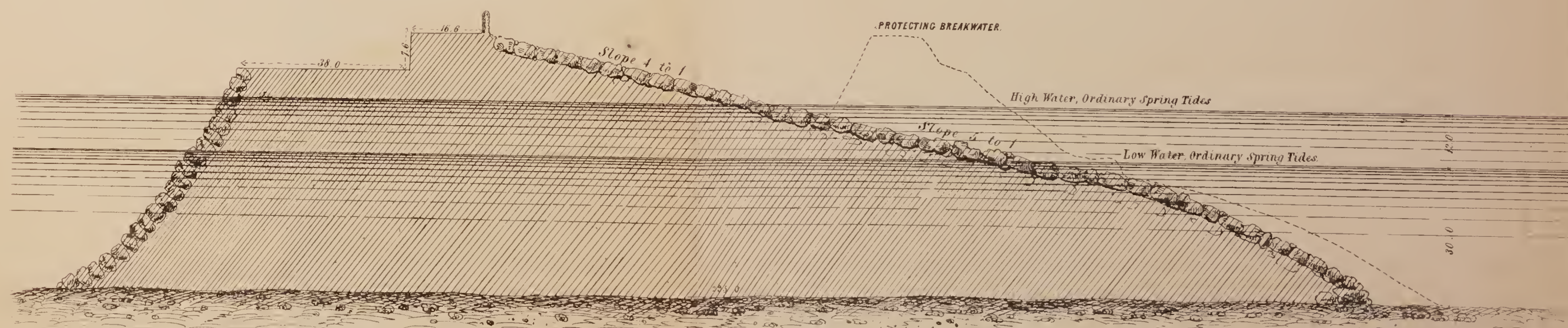
## SECTION B.

### REFERENCE.

AAA Shows the Seaward face as originally proposed.  
RRR Shows the Pier as constructed.



## SECTION THROUGH THE EASTERN ARM OF KINGSTOWN HARBOUR C.



To accompany Lieu<sup>t</sup> Col. Harry D. Jones's Letter dated 1<sup>st</sup> June, 1844.







## SECTION D.



*The Area of the Section of a Pier formed as proposed by  
Lt Colonel H.D. Jones as shown by the Shaded Figure and  
founded at the same depth as above mentioned. . .*

*To accompany Lieu<sup>t</sup>. Colonel Harry Jones's Letter, dated 1<sup>st</sup> June 1844.*

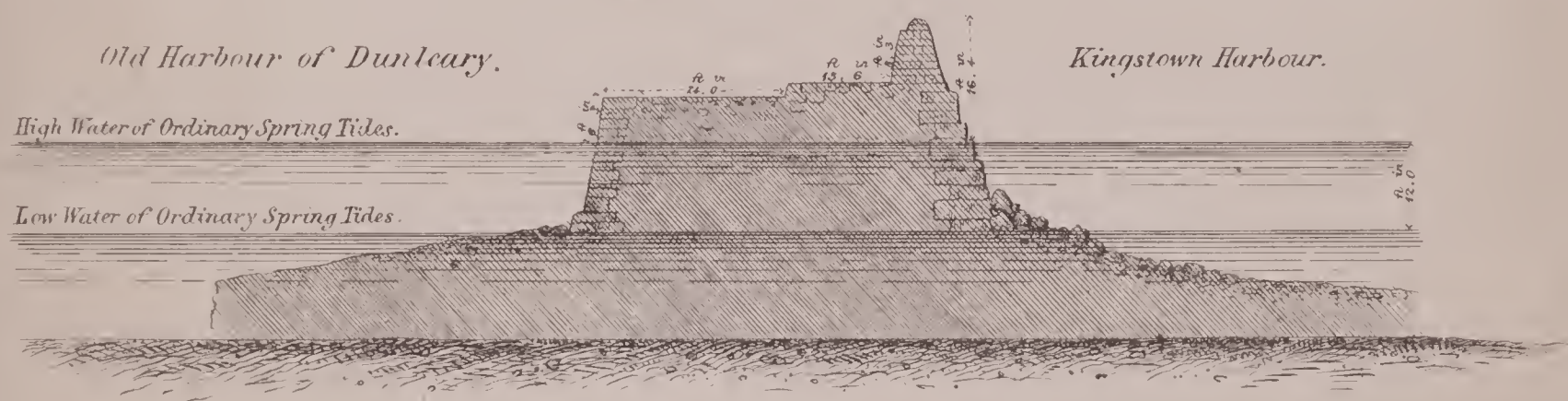






To face page 12.

OLD PIER OF DUNLEARY.  
TRANSVERSE SECTION THROUGH PIER HEAD.  
1844.



To accompany Lieu<sup>t</sup> Colonel Harry D. Jones's Letter June 1<sup>st</sup> 1844.







From the unanimous testimony of the older inhabitants of Harwich, it appears that Beacon Cliff (which is entirely composed of Blue or London clay, with layers of *Septaria* or Cement stone), has fallen away much more rapidly within the last 25 years than it did at any previous time; but not feeling quite satisfied with this evidence, I have procured plans of the town and cliff for the years 1709, 1756, and 1804, and have transferred the high and low water lines for these several periods to the plan of Harwich, completed last year in Her Majesty's ship *Shearwater*. From which it appears that in the first half century less than 40 feet, or not a foot a year, of the cliff was washed away; in the second half century about 80 feet went to sea; while during the last 37 years the sea has advanced in a direct line upon the land not less than 350 feet; and the beach at the foot of the cliff has been so much lowered that the low water line, during this short period, has gained 600 feet upon the shore; thus presenting on the western side a greater surface of water, whereby the scouring effect of the flood and ebb streams in keeping the channel clear is much weakened; a barrier that tended to shoot the ebb tide over against Landguard Point is removed; full 40 acres of ordnance, glebe, and manor lands, of excellent pasturage, with tenements and other property, have been swept away, and the harbour deprived of an invaluable breakwater in southerly and south-westerly gales.

Report of  
Capt. Washington.Loss of Beacon  
Cliff.Evidence from old  
plans.

Now, the traffic in cement stone began about the year 1812, or 30 years ago, since which period, I am credibly informed, that upwards of a million of tons of this stone have been carried away from the shores in question. This fact, combined with the evidence derived from the plans, seems conclusive as to the cause of the encroachments of the sea upon Beacon Cliff.

Traffic in cement  
stone.

But while the sea has gained upon the land on the western side of the harbour, the contrary has taken place on the eastern or Suffolk side, where within the last 30 years Landguard Point has grown out 1,500 feet, thereby blocking up the chief entrance into the harbour; so that where in the year 1804 was a channel seven fathoms deep at low water, is now a shingle beach as many feet above high-water mark.

Extension of Land-  
guard Point.

This mischief has been accelerated by carrying away the cement stone from the foot of Felixstow Cliff, about two and a half miles to the north-eastward, where it formed a rocky projecting ledge which served as a breakwater, for the whole of this shore, from the force of the sea in north-easterly gales. But since this stone has been removed (to an extent of 200,000 tons I am told), a large slice from Felixstow Cliff has gone into the sea, two mortella towers and a small battery, only built in 1808, have been swept away, and the beach at Landguard Point has grown out, as above stated, to the extent of 500 yards, in consequence of which the two lighthouses, erected but a few years since at a great expense, are no longer a safe leading mark into the harbour; on the contrary, they have already caused serious damage to several vessels by running them ashore.

Felixstow Ledge.

These are great and increasing evils, and demand immediate attention, if the port of Harwich is to be preserved.

It is the province of an engineer to point out the proper remedy to take, but the more obvious measure would seem to be to put an immediate stop to the daily practice of carrying away cement stone from the foot of the cliffs, and to replace by an inexpensive breakwater of rough stone run out about 800 yards, the natural barrier which has been carried away from the foot of Beacon Cliff, whereby the ebb stream will be again directed against Landguard Point, so as to prevent its extension, and the shelter to the outer part of the harbour in northerly and southerly gales will be restored.

Remedy recom-  
mended.

Of the large quantity of cement stone that has been carried away from under Beacon Cliff, I am informed that 200,000 tons have been taken by the Board of Ordnance, and applied to Government uses.\* If such is the case, perhaps it might not be considered as expecting too much to call upon that Board to protect the cliff from further encroachments, and to replace by groynes, or other artificial means, the natural breakwater that they have been instrumental in causing to crumble into the sea, and thereby most seriously damaging the harbour.

Mr. Walker and Mr. Rendel have recommended a pile jetty along the northern face of the town, in which I fully agree; but the interests of navigation require that some care should be bestowed in preserving and improving the present channel into the harbour. Since the deep water entrance by Landguard Point is lost (certainly for some time to come,) the actual channels should be dredged so as to command a depth of 15 feet at low water, or 27 feet at high-water springs; this would be attended with little expense, as the dredgers now on the spot would gladly undertake the work for a bounty of 1s. a ton on all the cement stone taken away from the different shoals in the harbour, and there would be no difficulty in pointing where and how this might be done to the greatest advantage.†

A pile jetty recom-  
mended.

Dredging proposed.

A small red harbour light would also be required to be placed about 25 yards to the southward of the present low light, to obviate the mischief now of daily occurrence, in consequence of the two lights in one being no longer a safe leading mark to clear Landguard Point. The harbour buoys might also be much more advantageously placed than at present,‡ and two or three small beacons would be required; but the greatest improvement to the navigation of this part of the coast would be a small floating light near the entrance of the harbour, and a fixed light at the tower of Walton-on-the-Naze.

Improvements in  
surveying.

The above recommendations are suggested not only by the increasing trade of the ports of Ipswich and Manningtree, of which Harwich is the outlet, and by the extent of the Government property in the town, but more especially by the present value of this harbour as affording shelter to the vast body of shipping that daily pass along the east coast of England in winter as well as summer, and the facility with which assistance is rendered from this port to vessels wrecked on the Shipwash to the north-east, and the West Rocks, and Gunfleet Sand to the south-east, perhaps the most dangerous sands in these seas. It is well to bear in mind what this port was during the last war, and what it must again become for another North Sea fleet. It was from Harwich that the Hollesley Bay fleet was always watered by transports; it was here that all vessels, from a frigate downwards in case of need came for a partial refit at the naval yard still in existence; here not less than 60 ships of war have been built, 15 of which were two-deckers, while the tonnage of the vessels employed in the North Sea Fishery belonging to Harwich, a few years since, was estimated at 3000 tons, employing 500 hardy seamen.

Increasing trade.

Hollesley Bay, fleet  
watered here.

North Sea Fishery.

These considerations alone would more than justify any small outlay to preserve this port from further damage, but in addition it should be remembered that this may shortly become the packet

Probable mail  
station.

\* The Ordnance have had a cement mill at Harwich, since the year 1818, let the greater part of the time for 500*l.* a year: and now at 300*l.* a year.

† The Admiralty have since granted 100*l.* for this purpose, besides which the Corporation of the borough of Harwich have liberally expended a similar sum, with which 520 tons of soil were dredged up; 70 tons of this were of cement stone, worth 5*s.* a ton.

‡ These alterations have since been made by the Trinity Board, with the invaluable addition of a light vessel placed near the entrance of the harbour.



Report of  
Capt. *Washington*.

Steamers put in for  
fuel.

station for all our mail communications with northern and central Europe, that as soon as the railroad, already open to Colchester, is completed to Harwich, letters dispatched from the General Post-office might be delivered in three hours direct on board the Mail Steam Packet lying waiting alongside the pier,—that passengers could walk on board, and in less than a quarter of an hour be clear out at sea, in all weathers and at all times of tide, and 60 miles ahead, even in fine weather, of those mailed at the same time in London, which would probably make the difference of a whole tide in arriving off Ostend or the Brille, or other bar harbours, while in north-easterly gales and fogs steamers would often make their passage before those starting from London could get clear of the shoals and currents of the deep gulf which forms the estuary of the Thames; in proof of which 28 steamers, carrying mails, in spite of strict orders to the contrary, have been compelled to put into this port for fuel, or to land their mails, after contending for upwards of 24 hours against strong head-winds, which prevented their making their voyage.

Under these points of view, then, but chiefly as the Packet Station for all northern and central Europe, (thereby avoiding the less expeditious and less secure transit through France,) the preservation of this port appears to be of national importance.

JOHN WASHINGTON,

*To the Secretary of the Admiralty.*

*Captain of Her Majesty's Ship "Shearwater."*

Proposition for a  
Harbour at Dover.

### PROPOSITION FOR A HARBOUR AT DOVER.

SIR,

2, Craven-street, Strand, 29th June, 1844.

HAVING been requested by the Harbour Commission to form an opinion, and to furnish a plan for a harbour of refuge at the Bay of Dover, I have now the honour of submitting the same.

The proposition, I understand to be as follows. Supposing the site of Dover Bay to be fixed upon for the construction of such a work, what are the best dispositions for the piers to enclose the anchorage; what the best and most practical material and method for the construction of those piers, and where the entrances can be placed with most general advantage? I further understand that it is desirable the interior area, with three fathoms water and upwards, should not be less than 225 acres, but as much larger as circumstances and reasonable economy will admit of. The form and extent of the harbour which I now propose (as the maximum which can be conveniently obtained) contains 340 acres of three fathoms and upwards, the length from east to west is 2833 yards, and the breadth 1183 yards; and by taking off 800 yards from the eastern end, and preserving all the other features the same, a harbour may be formed which I should deem a minimum size, suitable to the objects in view, and this would contain about 250 acres of three fathoms and upwards, and between these two sizes any intermediate one may be formed upon precisely the same principle, merely by producing or shortening the eastern boundary within the 800 yards already mentioned.

The site of Dover Bay for a harbour of refuge is attended by several particular difficulties, which the engineer must endeavour to provide against.

1st. The slight indent which the bay forms with the shore, leaves the anchorage entirely open on two sides, and fully one-half on the third side, and therefore artificial shelter has to be furnished to a great extent.

2nd. The bay possessing no natural back or scouring-water, or permitting of an artificial one to any sufficient extent to keep the anchorage deep and clear, it follows that in rendering the interior sheltered and tranquil by solid enclosures, every facility is offered to the deposition of fine sand and silt, to the injury of the anchorage; and in my opinion this circumstance is the most important the engineer has to deal with, and provide against.

3rd. At Dover Bay there is a great flow or drift of shingle to eastward, which has materially filled the bay, and to a great extent has choked the entrance to the present tide harbour, and which, unless attended to, may also choke the entrance to the harbour of refuge.

4th. The situation of Dover Bay is a very prominent and exposed one, and the necessary works are therefore likely to meet every impediment from the elements during construction, and to be severely tried when finished, and they must therefore be disposed in such a manner as not to encounter or provoke avoidable assaillance.

Having been favoured with the loan of the plan of Dover Bay, so recently and accurately surveyed by the officers of Her Majesty's Ship *Blazer*, I have been enabled to perceive the natural features of the bottom, and to study the influence of weather and currents upon it.

The soundings being laid down to every foot of depth, has permitted me to draw numerous contour lines; and the lines of currents being marked, the effect of the latter upon the configuration of the bottom (as developed by the contour lines) can readily be conceived. On the surface of the bottom there appear slight grovings or channels, and slight swellings or ridges in the direction of the current, and parallel with the shore as might be expected; the 40 and 41-foot line of soundings show channels setting into the bay, and the 39-foot line of sounding outside of the last shows a bank or gentle swell of surface caused, no doubt, by the deflection of the stream into the bight of the bay; and the outer edge of the 42-foot line is equally significant of both these circumstances; the 49-foot level is particularly prominent, and shows a great tongue of sand extending off the bight of the bay for 7500 feet, and upon this tongue there occurs a shoal bank of 39 feet at 5300 feet from the shore, though to the east and west of the same the sounding is 60 feet; this tongue, on the 49-foot line of sounding, lying across the line of tide current, would indicate an eddy action produced by the disturbance which the recess of the shore at Dover occasions, and shows the necessity of avoiding any tendency to augment that action, and to create foul ground near the harbour of refuge.

*South Front of Proposed Harbour.*—In laying out this line I have been governed by several circumstances which fortunately have combined in the particular treatment required.

1st. I desired to place the line of the south front as nearly in the line of the current as practicable, that it might offer no disturbance to the same, but allow it to pass freely as before, on both sides of the pier, as I apprehend any interruption to the direction of the currents might be productive of great mischief in the formation of the banks and shoals, both inside and outside of the harbour; and with the same and other objects in view, I have designed capacious entrances at each end of the harbour, and have carefully abstained from any in the south front. The entrances at the two ends in the line of current I have, however, endeavoured to dispose with as much attention to shelter as possible.



If the entrances at both ends, or at one, were stopped, and others opened in the south front, the consequence would be, that as the tide flowed a current would pass into the harbour through the front entrances at right angles to the current outside, and carry with it a quantity of the material from the tongue or shoal alluded to, and deposit the same in the tranquil parts of the interior, as during the rise of the tide the only current in such a case would be inwardly, and though active at the point of entrance, it would speedily disperse and diminish, and permit of the deposit of the matter held in suspension at no great distance from the entrance, where it would remain; for on the ebb tide, though the current would only be outwardly, it would have little activity except near the openings; and though it could not materially remove the depositions from any great distance inside, it would scoop out a deep chanuel near the entrance, and in its conflict in meeting the outside current at right angles, a bank or bar would probably take place.

Proposition for a  
Harbour at Dover.

By having only two entrances, one at either end, in the direct line of the natural currents, we obtain a scour completely through the harbour, so that whatever material might be brought in through one entrance, would in all probability pass out by the other; and as a constant and thorough current and agitation would be kept up through the whole length of the harbour, the fine matter held in suspension would continue so until ejected at the opposite end. It may be considered a convenient arrangement besides the entrances at either end, to have a third for the passage of vessels in the middle of the south front. But that convenience would be dearly bought by the risks to which such an entrance would expose the harbour; as at certain times of the tide and wind, a cross or oblique current would be introduced to disturb the interior one, and when once a direct current is interfered with under such circumstances, it is difficult to foresee how much mischief may be done by the formation of banks.

I am therefore distinctly of opinion that if a harbour of refuge is constructed off Dover, it and should have two entrances, one at either end, in the direct line of the tides, and none on the south front; and though this may not be considered the most convenient arrangement for shipping, it must be considered as a necessary evil to avoid others of a more important and dangerous nature.

I have endeavoured to conduct the south front in as straight a line as other contingencies will permit of. If the southern or long front presented a convex form outwardly, such a disposition would give more capacity inside in proportion to the extent of pier used; but the corresponding concavity inside would present shelter for depositions to take place on; indeed whatever outline of pier be adopted for the south front, I am led to expect there will be a tendency to deposit on one or other, or both sides of it; but if the form be curved the deposition will form more extensively on the concave side, while the convex side would remain comparatively clear. But if we were to make the south front convex inwards, though that would tend to keep the anchorage clean, it would contract the area of the harbour and render the anchorage more exposed; and I therefore consider the straight line (or a form closely approaching it) as the most prudent and suitable, and what I have adopted in reference to other considerations is a front to the south composed of two straight lines meeting at an angle of  $172^{\circ}$ . The west branch is 1100 yards long, and its prolongation is directed (considerably within the line of Dungeness) upon Romney-mill nearly, and verging to the shore at Folkstone. The eastern branch of the south front is 1970 yards long, and is directed upon the South Calliper, and verging to the shore at the South Foreland, so that the end of each branch is well protected in its landward prolongation, and in their seaward prolongation they mutually protect each other; and these circumstances have induced me to diverge from the absolutely straight line to a small extent. The proposed south front faces the nearest part of the French coast, and therefore there can be no long fetch of the sea directly against it, and what there is must be much mitigated by tide currents crossing it.

The south front is doubtless the great and important feature of the harbour of refuge, and the weakest and most assailable from its extent and more exposed position; but it is fortunate it is not exposed to any formidable *direct* assault, the wind that would prove most injurious if exposed directly to it, would be near the south-west (by compass), or that coming in between the Varne Bank and Dungeness, but a sea rolling in for that quarter would meet the south face very obliquely; and the line on which the south front could be most directly and powerfully assailed is in some degree protected by the Varne and Ridge banks, and still offers an obliquity of  $30^{\circ}$  to the line of action upon it. Though the coast of Dover is much exposed, I consider the line of south front now proposed as the most favourably disposed to meet all adverse circumstances; but in fixing upon the line shown in the plan, I have not been inattentive to the form of the bottom of the sea where it is placed. With the same direction and form, the south front, might have been advanced more seaward, or retired more landward; and I have been induced to adopt its identical parallel position, to base it on a ridge or swell of the ground which extends in the required direction, and which encloses deeper water at either extremity than does the site of the pier itself; and though a difference of three or four feet of depth may appear of little consequence in the choice of a foundation, still it is important rather to place it on a swell of the ground, which indicates a slackness of current than in a hollow or channel which indicates a quickness of current.

*Western Entrance.*—The west pier head is formed on a rising portion of the bottom or low sand bank, which leaves a deeper channel inside, and the 40, 42, and 46 lines of soundings show that this pier-head is placed at a point where the main current bifurcates or diverges, one branch setting into the Bay of Dover, and the line of this diversion or separation of the stream is also that chosen for the line of the south front. On considering the qualities required for the west entrance, we have first, to attend to a free passage to the inset of the tide; second, to endeavour to exclude the shingle; third, to give the harbour inside as much shelter as circumstances will permit; and fourth, to throw such a current across the mouth of the present tide harbour as would clear away all accumulation in front of it, and give a clear entrance in future to that otherwise very excellent tide harbour.

To exclude the shingle, and to give the greatest shelter inside, it is necessary to run out a solid pier from the shore to the greatest extent consistent with a free entrance to the current; and that the current may freely pass into and through the harbour without eddies and deposits, it is necessary that this solid pier should point obliquely to the entering current; and I have designed a solid pier, commencing at the south pier-head of the present tide harbour, passing obliquely in front of Cheesman's Head, and terminating opposite the Bull Rock in 42 feet water, and at a distance of 383 yards from the shore, and formed on a line of double curvature, concave near the entrance to receive and direct the entering current, and convex towards the shore to give it the stream a clear passage across the mouth of the present tide harbour.

Against the pressure of shingle on the west side, this pier will present a slightly convex outline;



Proposition for a  
Harbour at Dover.

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and if in process of time the angular space outside should completely fill up with shingle, as most probably it would, it will then become necessary, from the head of the proposed pier to run a branch somewhat parallel with the shore, and two or three yards of annual extension on this line would probably suffice to contain the shingle, or, if deemed more advisable, a second or third pier or groin may be thrown out from the shore more to the westward; but let the work be which it may, I should most distinctly propose to apply works to intercept the passage of the shingle as an essential condition of the scheme.

The present tide harbour is a most important matter for consideration, from its costly quays and docks and warehouses, and if in addition to the shelter afforded to the entrance by the refuge harbour, the shingle is intercepted and a current brought across the mouth, it will hereafter be quite accessible to all vessels for which the interior has a sufficient depth of water; but it will become more accessible under these altered circumstances, if about 120 feet is lopped from the North Pier-head, which would widen the mouth and make the entrance more direct, but the curtailment of the North Pier would also be necessary for the free flow of the current through the refuge harbour, and would prevent some eddies and tendencies to deposit near the mouth of the tide harbour.

I admit that the proposed western entrance would leave the anchorage somewhat more exposed than I could wish, but amidst so many difficulties, it is impossible to provide equally for the whole, and it becomes a matter of judgment to attain the most numerous and important benefits with some sacrifice in other points, but the evil of insufficient shelter at the western entrance, if it should prove of any consideration, may be counteracted by a screen or detached pier inside in the position marked on the plan, and which might otherwise become useful as a site for a battery.

*Eastern Entrance.*—The east end of the south front is 966 yards from the shore, and it will form the South Pier Head of the east entrance, which I propose to make 373 yards wide, the remaining portion of the distance being enclosed by a pier 547 yards long projecting from the shore, the prolongation of which forms an angle of about  $89^\circ$  with the east branch of the south front; this direction of the East Pier makes it form an angle of about  $75^\circ$  with the general line of shore outside, and an angle of  $105^\circ$  with the shore inside, and this disposition I have adopted from two considerations:—1st. That the east end of the south front may be more able to shelter and protect the entrance; and 2ndly, that the westerly set of current may the more effectually enter and be conducted through the harbour; in most of the projects for a harbour at Dover, a contrary plan is adopted, and the Eastern Pier forms an obtuse angle with the shore outside, but this must tend to deflect the westerly set of current to the outside the harbour, instead of through it, and if I have adopted any prevailing principle more than another, it is that of procuring a direct and thorough current through the harbour to prevent all deposition and tendency thereto.

By reference to the plan, it will be seen that the East Pier forms a deep and dead angle inside, which will naturally be tranquil, and where silt will deposit, and where the shingle already inside will accumulate, but the sooner that dead angle silts and shingles up the better, as the contour thereby given naturally to that portion of the harbour will tend much to improve the currents and channels elsewhere, and it will become a receptacle for all excrescences in the bottom likely to be removed; thus in the improvements at the west end, I expect the shingle lying at the mouth of the tide harbour will travel along the shore until intercepted by the East Pier, and this action may be more effective, if besides lopping off 120 feet from the North Pier Head of the tide harbour, as already mentioned, we also cut off as much of the Castle Jetty, (or Smith's Folly, as it is sometimes called,) as might be safely attempted in respect to the buildings on the line of shore. When the corner formed inside by the East Pier is once filled, all farther travelling matter would pass through the east entrance by the increased power of the current; indeed, if I did not expect that this nook would fill up, I should propose to make the East Pier still more oblique to the shore to give the issuing stream a more gradual convergency and more effective action outwards.

I have now concluded what is necessary to state in respect to the *linear form* of the proposed harbour and its entrances, and I have next to notice the materials and the form and mode of structure of piers most suitable to the locality.

From the reasons given in my Memoir on Breakwaters, (laid before the Admiralty last October and now referred to your Commission,) confirmed by practice and supported by theory, I should distinctly object, to all tumble stone breakwaters with long seaward slopes, and I should deem it most imprudent to recur to such a principle in spite of such dear bought experience, particularly at so exposed a site as that of Dover.

If we could choose the kind of sea-wall most desirable for a harbour of refuge, we would prefer a solid wall of granite masonry rising boldly and nearly perpendicularly out of deep water; but when we enter into the difficulties and expense of preparing foundations for them and carrying on such a structure on so exposed a coast, we soon perceive that the time and expenditure required would be so great as to render it impracticable on the usual mode of proceeding.

Some have proposed a combination of the tumble stone breakwater and a solid pier of masonry, that is, to form a foundation with tumble stones to low-water mark, and from this to carry up a solid wall nearly perpendicular, and this modification would no doubt be a great improvement on the old plan, as has been pointed out particularly by Colonel Harry Jones, because the most destructive action of the waves is between the high and low-water marks, while below the latter, the destructive action is comparatively feeble. Such a structure, in many places, might be very suitable, but it may be doubted whether it would be altogether appropriate on the coast off Dover. The objection which has been urged against this combined plan, is, that should the foundation of loose stones by any accident give way the solid pier must fall also; it appears also to me, that in respect to harbours with narrow entrances, that the system of tumble stones, whether carried up to high or low-water mark would much obstruct the entrances, for at openings with 42 feet of depth at low water, the bases of such structure would occupy 480 and 336 feet of the breadth of entrance respectively.

As preferable to either of the above plans, I should adopt the plan of a double row of iron caissons of a triangular section filled with concrete within and between, agreeably to the diagram I furnished the Commission, and suggested by the wooden caissons, proposed by Mr. Cubitt, as the core of a tumble stone breakwater; but at the same time, I think a fair field of competition is open between this mode and that of using upright rods of malleable iron in the manner pointed out in my memoirs on the subject already alluded to and printed in Weale's quarterly papers on engineering.

Against that plan, it has been urged, that malleable iron is subject to decay in the sea. I however do not admit that good iron is so perishable in sea-water as many allege, and we have lately had



## DOVER BAY,

IN APRIL 1844.

Surveyed in H.M.S. Blazer.

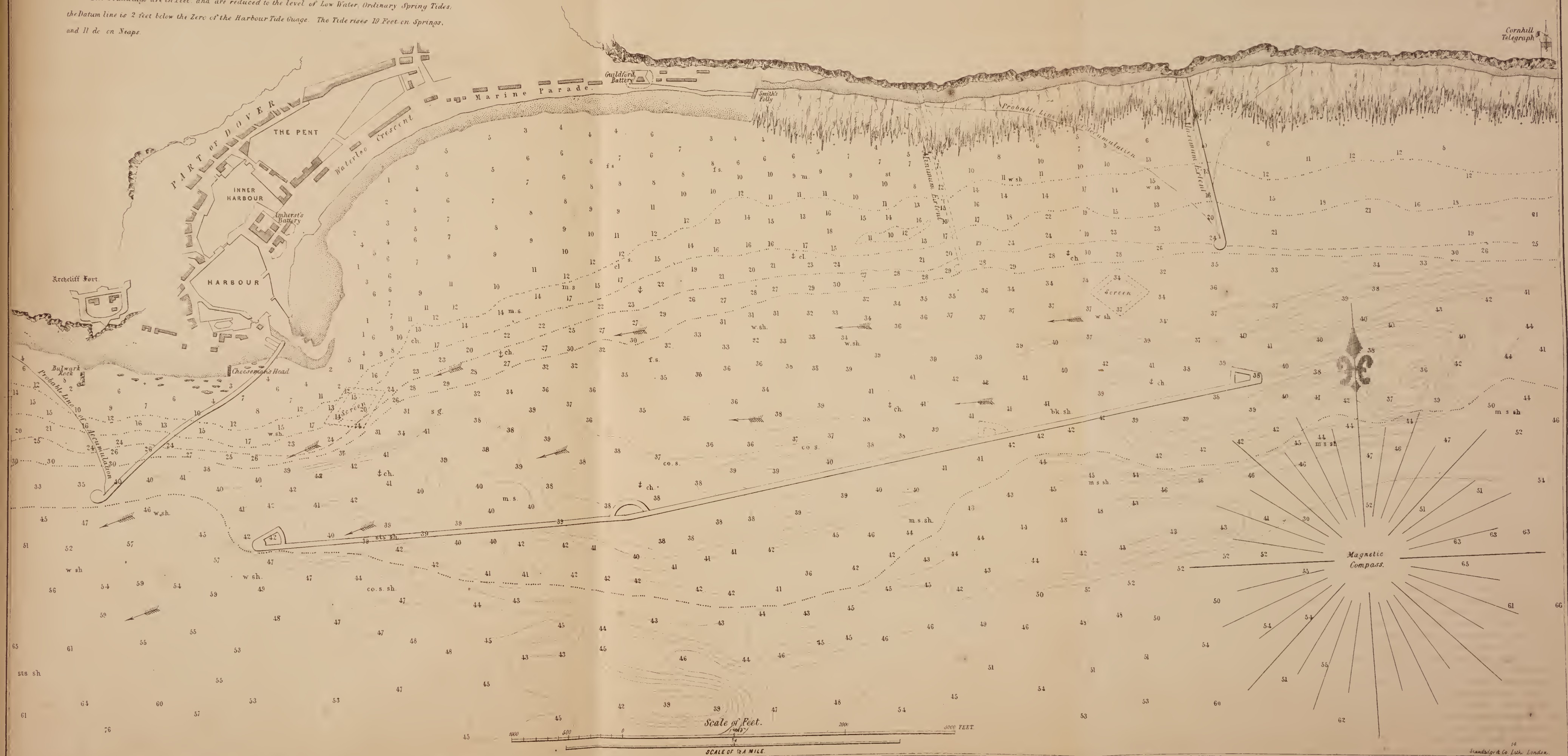
Castle Flagstaff

## OUTLINE FOR A HARBOUR OF REFUGE,

As proposed by Capt<sup>l</sup> Vetch, R. E. in hisReport to the HARBOUR COMMISSION, 1<sup>st</sup> July, 1844.

Lines of Equal Soundings or Contour lines are inserted to shew the features of the bottom of the Sea.

The Soundings are in Feet, and are reduced to the level of Low Water, Ordinary Spring Tides; the Datum line is 2 feet below the Zero of the Harbour Tide Gauge. The Tide rises 19 Feet on Springs, and 11 feet on Neaps.









several structures, as beacons and lighthouses, supported in salt water by iron rods. Yet, if I admit the validity of the objection to the fullest extent, my answer is, that my skeleton piers of iron, admit, with facility, of being made solid in a variety of ways and by a variety of materials, whenever through symptoms of decay or from any other cause the operation may be deemed requisite, but by filling up the structure solid as it progresses this objection has no room to exist.

And if I look at these piers of iron framings, merely in the light of a preliminary measure to other operations, I am of opinion, that a solid structure may be more expeditiously and more economically procured through means of such an auxiliary than by any other mode now in practice, and if I were required to carry out solid walls of granite off Dover, I would, as a preliminary measure, carry out in advance a pier of iron rods. If however a pier of iron rods is carried out on the skeleton form, it can be made, at little additional expense, capable of intercepting the undulations of the sea as effectually as granite itself; and it might be time enough to incur the additional expense of solidifying it, when the iron gave symptoms of decay. As to the precise mode of applying solidity to the structure so many methods have presented themselves, that I have not as yet been able to fix on the most eligible, but must leave that point open for farther consideration; as I have however in my evidence, alluded to the combination of the principle of iron rods with that of iron caissons, I shall here offer one illustration. Suppose a pier of iron rods to be carried out in a perpendicular form, for 100 yards in advance of the solid structure, I might place a half caisson on either side; that is to say, a caisson of the shape of those proposed, as divided in two by a plane passing longitudinally and vertically through the apex of the triangular prism.

These caissons would have one upright side placed against the side of the pier, the other side sloping outwardly at 30 degrees from the perpendicular. The iron rod pier would give every facility for accurately and conveniently placing these caissons in their position, and when there, the same facility would be offered for filling them with concrete, or brickwork, or masonry, &c., and as the double line of caissons advanced enclosing the pier, as many of the upright rods as might be deemed necessary might be drawn, and the interval filled with concrete, rubble-work, or other material.

With respect to the progress of the works, the end, or wing piers, could be proceeded with independently from the shore, and in regard to the south front, I do not apprehend any very great difficulty in establishing two or three starting points, and of progressing from these with one or two ends, and in that manner, I consider the work might be completed (at least in the skeleton form) in three years, if the materials were in timely preparation. I am however quite aware of the great accommodation of keeping up a continuous communication with the shore, and it might become a question whether it might not be most advisable to proceed from the two extremities of the harbour at the shore, and to work from two ends towards a centre, leaving the spaces about to become entrances in the open skeleton form of pier, and afterwards to remove the materials when the two ends nearly approached the centre.

*Estimate of Expense.*—This is about the most difficult problem to solve in respect to the proposed harbour considering the exposed situation off Dover with tides of 19 feet rise and fall, and with no aid from natural features or foundations and the extent of the necessary works; the cost of enclosing Dover Bay on any kind of structure must be very considerable, for allowing six feet for foundation and six feet above high-water mark, the height of the required piers would be 72 feet, and the extent of walling, though not all of that height, would amount to 4304 yards, the cost of which on the most economical plan, would not be less on the average than 300*l.* per yard, which would give a total of 1,291,200*l.*; I should however observe, that the harbour as now required and proposed, is considerably more extensive than that estimated for by the Government Commission in 1840, and of that subsequently estimated for by Mr. Cubitt.

I have the honour to be,

Sir,

Your most obedient Servant,

JAMES VETCH.

Admiral Sir Byam Martin, G.C.B.,

Chairman of the Harbour Commission.

*Her Majesty's Ship, "Blazer," East Bourne Bay,  
June 25, 1844.*

SIR,

IN compliance with your instructions of the 7th June, I have now the honour to lay before you a new survey of East Bourne and Pevensey Bays and the Royal Sovereign shoals, on the scale of four inches to a mile, nearly, which has been completed by Lieutenant Cudlip and Mr. E. K. Calver, Assistant Surveyors of Her Majesty's Ship "*Blazer*," during the past fortnight.

The partial survey of the in-shore portion of the bay, by Captain Bullock and Mr. Burstall, R.N., for the use of the Harbour of Refuge Commission, of 1840, we have found, as far as it extended, to be perfectly correct; but on comparing our recent examination with those of 1809 and of 1826, published by the Admiralty, which are the latest and indeed the only charts extant, the chief alteration of feature appears to be, that a closer examination has brought to light more shoal patches, inasmuch, as by the former, only nine spots of less than 5 fathoms water appear, in the present, there are, I regret to say, as many as 21 detached shoals of that depth.

The remarkable projection of the Holywell Bank, beyond the pitch of Beachy Head, is now accounted for by the extension of the chalk ridge called Beachy Head Ledge, which we find to run out in a south direction above a quarter of a mile below low-water mark. This ledge, and Beachy Head itself, are the cause of the sand named the Holywell or Sand-acre, which is an extensive flat, having generally nine feet of water over it; towards its eastern end the fishermen call it the Boulder Bank, owing to some flint boulders found upon it. This bank is distinct from the Holywell Ridge which lies inside of it.

Although, at first sight, this sand appears much in the way of shipping rounding Beachy Head to seek shelter in the bay, it does not seem to have been the cause of any wrecks of consequence, and it certainly is of benefit in preventing the weight of the sea from setting home on the beach, as we learn not only from the fishermen here, but also from our own experience, while lying in this bay during a strong south-west breeze.

We found the holding-ground good wherever we anchored, and generally clay or soft chalk. On one occasion, off Langley Point, our anchor brought up a large mass of pebbles or shingle, embedded



Royal Sovereign shoal.

in clay, resembling a soft plum-pudding stone, the only instance in which I ever remember finding shingle below the range of low-water mark.  
On the Royal Sovereign shoal, so called from a ship of that name having grounded in it in 1756, we had a cast of *ten feet* water only, and the lead brought up red clay of as bright a colour as red lead.  
The tides were carefully watched during the survey by Lieutenant Conjuit, R.N., the officer of the coast guard on this station ; and I have much pleasure in stating that here, as well as elsewhere along the coast, I found the greatest readiness on the part of the coast guard officers and men to forward the service in any way in their power.

Tides.

Spring tides rise 20 feet, and the neaps 13 ; and the stream of tide, both on flood and ebb, sets fairly through the bay at the rate of two knots at springs and one knot at neaps. The time of high water, contrary to our expectation and to all Channel sailing directions, is nearly half an hour later than at Dover.  
I have little to add to my former report in April last on this bay, except to say, that a more detailed examination has entirely altered my preconceived opinions, and confirms me in the opinion I then felt myself obliged to express that, although Beachy Head affords fair natural shelter in the prevalent westerly gales, and although there is no part of the Channel in which a harbour is more desirable than in this vicinity, still it would hardly be prudent to hold out any inducement to lead vessels into East Bourne Bay, for it would be difficult to place a breakwater there in any position in which a ship would not risk getting into three-fathoms water in entering or leaving by its eastern opening, and thus encounter a heavy broken sea ; or, yet worse, would risk getting entangled by the more dangerous rocky shoal of the Royal Sovereign or the Horse of Willingdon, in the very possible event of missing the port when running for it in a south-west gale and thick weather.

Difficulty in placing a breakwater.

Dungeness.

DUNGENESS.

Swallow Bank.

On our return to the eastward, having the advantage of a tide-scale, well fixed at East Bourne, and another at Dover, we re-examined with much care the Swallow Bank, in Dungeness East Bay, and found it, as I before stated, to have decreased nearly half its whole size in extent, and that the depth of water has increased on it from 16 feet, as represented in former charts, to 22 feet at low-water springs.  
We also tried experiments, in compliance with your instructions, on the nature of the bottom off the pitch of Dungeness. This we did by means of a circular scraper, or iron bucket, with a sharp lip, attached to the palm of a small anchor, and having let it go at every two fathoms depth, from 3 out to 20 fathoms, we found that, with the exception of the first, which was shingle (at not half a ship's length from the beach) each time the anchor brought up mud, without the trace of a pebble. The slope of the bottom, from low-water mark seawards, as far as 16 fathoms, was found to be as follows :—

Quality and slope of bottom.

	Foot.	Feet.		Foot.	Feet.
To 2 fathoms . . . .	1	in 21	From 10 to 13 fathoms . . .	1	in 9
From 2 to 4 fathoms . . .	1	in 12	From 13 to 14 „ . . .	1	in 38
From 4 to 7 „ . . .	1	in 5	From 14 to 15 „ . . .	1	in 38
From 7 to 10 „ „ (at 180			From 15 to 16 „ „ (at 430		
yards from the beach) . .	1	in 3	yards from the beach) . .	1	in 40

then flat for a considerable distance to seaward. This is more distinctly shown in the plan.

No shingle below low-water mark.

On landing on the beach in East Bay, about three miles from the Ness, I found blue clay on the surface at about half way down to low-water mark, and the fishermen told me it was a common practice, when they wanted worm for bait, to shovel the shingle aside, when they soon came to the clay in which the worm lives.  
The officer of the coast-guard at No. 2 battery, Lieutenant Coombe, R.N., had taken much trouble to dig down into the shingle on the beach above high-water mark but found it difficult, and had not succeeded in getting below six or seven feet. He stated, however, that his well was 15 feet deep and that the bottom of that was certainly clay.  
Captain Peat, R.N., Inspecting Commander of the district, is of opinion, that the shingle is 20 feet deep, but I am not aware that he has been able to bore to that depth at any spot ; nor has Captain Kerr, R. N., who has taken a great deal of trouble in trying to bore through the shingle, been more successful at Weymouth.

Dungeness and Chesil Banks.

Upon the whole I find nothing to alter my opinion that Dungeness, as well as the Chesil Bank at Portland (the isthmus which connects the island with the main) are both alluvial deposits of clay covered with a superficial stratum of shingle ; at Portland, heaped up occasionally to a height of from 20 to 30 feet on the crest of the ridge ; at Dungeness seldom exceeding from 8 to 12 feet in depth, and that only on the crest of the wave-like furrows which cover this remarkable shingle waste over an area of about 4000 acres in extent.

Record should be kept.

An accurate record of the movement of the shingle and of the growing out of Dungeness Point, would have been of great value, and it is much to be regretted that none has been kept beyond the single inscription in the lighthouse, that when built in 1792 it stood at 100 yards from the sea.

Dover Bay.

DOVER BAY.

Experiments on water.

Taking advantage of the spring tides, we anchored the "*Blazer*" in seven fathoms at low water as nearly as possible in the southern entrance of the proposed asylum harbour in Dover Bay, and according to your directions, took up about a gallon of water at different depths and at different states of the tide, namely, from the surface at low water, at half flood, at half ebb, and at high water ; also at a depth of 9 feet and 18 feet respectively at half ebb, half flood, and high water, thus producing eight samples of water at different states of the tides, all which are sent to the Museum of Economic Geology for examination as to the quantity of matter held in suspension.  
As these experiments were made in calm weather, I left my apparatus with Mr. Morgan, of the Revenue Service, with directions to take up the same quantities at similar states of the tide, towards the close of the first gale of wind from the south-west.  
From the appearances of the water I do not anticipate that any great quantity of matter will be found in suspension, but even admitting that such should be the case, (and from the recent disturbance at Round-Down Cliff, owing to Mr. Cubitt's masterly explosion, which has driven a quantity of loose chalk into the sea hereabouts, it is fair to expect it for the present,) an easy remedy exists, by

Round-Down Cliff.



increasing the area of the proposed harbour in Dover Bay, as I fully agree with Mr. Rendel, who tells us in his evidence on this very point, "that the larger the area the more likely to have a successful result." Nor has any instance yet been adduced, as far as I am aware, of a large harbour silting up; Ramsgate, with its insignificant area of 42 acres, receiving all the sewerage of a large town, and situated just at the embouchure of the river Stour, is no case in point. Kingstown, of 250 acres, we learn in evidence, does not silt up, how much less then need we expect such a result in Dover Bay, where the proposed harbour cannot have an arca of less than from 500 to 600 acres in extent.

No reason to fear silting up.

Admiral Sir Byam Martin, G.C.B.,  
                  &c.                  &c.                  &c.

I am, &c.,  
JOHN WASHINGTON, Captain.

Museum of Economic Geology, (Laboratory),  
July 12, 1844.

REPORT ON the SPECIMENS OF SEA WATER, received from the Harbour Commission,  
5th July, 1844.

Report on Speci-  
mens of Sea Water.

The bottles containing the sea-water were marked as under, the quantity of each specimen was measured, and the whole submitted to filtration through paper. They yielded the annexed quantities of suspended matter, and I enclose the paper filters by which the matter was separated, and which now contain it. The quantity operated on in each case varied from 182 to 216·6 cubic inches, or about 5 to 6 pints.

DOVER BAY.

2nd July.—Spring Tides—Calm Weather.

		Depth of Water whence taken.	Suspended Matter, per Cubic Foot.
		Fathoms.	Grains.
Low-water	at surface . . . . .	7	10·21
Half-flood	{ ditto . . . . .	8½	13·2
	{ at 9 feet below surface . .	7	6·
High-water	{ at surface . . . . .	10	3·43
	{ at 9 feet below surface. . .	8½	7·21
	{ at 18 feet below surface . .	7	11·53
Half-ebb . .	{ at surface . . . . .	8½	6·38
	{ at 9 feet below surface. . .	7	6·92

The quantity of suspended impurity I obtained from Thames water, about four years since, taken at three different places when no rain had fallen for about a month, the water being consequently clearer than usual, was as follows:—

	Grains.
Taken at Brentford—the cubic foot contained of impurity	1·75
,, at Hammersmith	1·83
,, and at Chelsea	4·15

The sea-water impurity, taking the mean of the foregoing statements, is to that of the river impurity as 8·11 to 2·57, or about as 16 to 5.

R. PHILLIPS.

Museum of Economic Geology,  
July 25, 1844.

SIR,

IN answer to your letter of this day's date, I beg to state, that the matter ascertained to exist in the Dover water is so very small in quantity, that it would be difficult to ascertain its nature unless a large portion were suffered to deposit at Dover, and the residue were sent to me for analysis. If I were to give an opinion merely, I should say, that the impurity is composed of some earthy matter, probably chalk and sand, mixed with vegetable matter, i. e., small particles of sea-weed. I certainly do not consider the quantity of impurity to be large in proportion to the water, and believing as I do, that a portion of it is vegetable matter, I am of opinion, that this, if it were ever deposited, would float off on the slightest agitation. I have now to report the suspended impurity of the sea-water last sent to me for examination; there were six specimens marked as under:—

DOVER BAY.

17th July.—Spring Tides—Strong Breeze from South-West.

		Depth of Water whence taken.	Suspended Matter, per Cubic Foot.
		Fathoms.	Grains.
Low-water	at surface . . . . .	7	10·26
Slack-water, flood,	at 9 feet below surface . .	7	51·29
	{ at surface . . . . .	10	24·10
High-water	{ at 9 feet below surface . .	8½	22·28
	{ at 18 feet below surface . .	7	53·76
Half-ebb	at surface . . . . .	8½	30·93



Report on Specimens of Sea Water.

The quantity operated on was, in each case, about 9 pints; and I forward herewith the filters containing the impurity from each sample.

I have the honour to be, Sir,  
Your obedient servant,  
R. PHILLIPS.

Admiral Sir T. Byam Martin,  
&c. &c. &c.

Museum of Economic Geology, (Laboratory,)  
August 2, 1844.

SIR,

CONFORMABLY to the request of the Chairman of the Harbour Commission, I have analyzed a portion of the substances deposited from the sea-water from Dover Bay, and I find that they consist of—

Sand . . . . .	52·0
Chalk, with a little clay and oxide of iron . . . .	24·0
Vegetable matter. . . . .	24·0
	<hr/>
	100·
	<hr/>

I am, Sir,  
Your obedient servant,  
R. PHILLIPS.

Spencer Westmacott, Esq.,  
Secretary.

Extracts from Paper by Mr. William Walker, Plymouth.

EXTRACTS FROM A PAPER, BY MR. WILLIAM WALKER, READ AT THE GEOLOGICAL SECTION OF THE BRITISH ASSOCIATION AT PLYMOUTH.

July, 1841. “ I have collected and arranged a few facts in connexion with these animals, and obtained from the breakwater a few specimens to show how they puncture, enter, or perforate the stone. The existence of these shell-fish, (*Saxicava rugosa*,) and their mode of action, as well as the changes they are capable of producing, may be demonstrated to those who may be sceptical on the subject.”

1st. “The buoys placed upon the shoals in Plymouth Sound were formerly moored by chains fixed to large blocks of Portland stone. On examining these stones, after being two or three years in the water, I found them punctured on the surface; and on breaking off portions of the stone, the *Saxicava* was found lodged within it.”

2nd. “The sea-walls of the Dockyard at Devonport had been built of Portland stone, and every where below the low-water level of spring-tides, the wall is honey-combed or frittered away.”

3rd. “In preparing the foundation of the sea-wall of the Royal William Victualling Yard, at Devil’s Point, the diving bell was used to cut away the limestone rock at the bottom, and these rocks were much drilled by the *Saxicava*. It is between Devil’s Point and Mount Edgcumbe, in a channel about 200 fathoms wide, through which the tidal waters of Hamoaze pass. The bottom of the channel as well as both sides of it are of limestone formation, the cliff at Devil’s Point on the east side is actually undermined by the *Saxicava*, and the Channel here is three or even four times deeper than Plymouth Sound. The tidal stream here is more rapid than in any other part of the harbour, and consequently the rock, forming the bottom, is kept clean and clear from deposits of mud or sand, we may therefore infer that the great depth of water in the narrows is owing to the operations of the *Saxicava*, as pieces of limestone perforated by these animals have been brought up by my trawl from 20 and 25 fathoms water, south-west from the Ram Head.”

“A narrow strip of limestone may be traced from near the Obelisk in Mount Edgcumbe, running in an easterly direction through Stonehouse, Plymouth, and Catwater, consequently the south boundary of the harbour as well as part of its bottom is limestone, and wherever we are enabled to examine these rocks at low-water spring-tides, we find them honey-combed and inhabited by the *Saxicava*, and it is over the limestone bottom where the deep water is to be found.”

“Drake’s Island and all the shoals near it are of the red sand formation. The island is surrounded with rocks and shoals, a flat sandy bank extends near one-third across the Channel towards Stonehouse, and there are 12 or 15 feet water on this bank, when it terminates at once by plunging into depths of 50, 80, and 120 feet over the rocky limestone bottom.

“From what has been stated, it results, that taking the mean level of the sea as a *zero*, from which to compare relative heights on land or depths in water, the submarine limestone rocks that form the bottom of the sea at Plymouth, are at a *lower level* than the other hard rocks.

“It will be seen by the specimens now produced, that the destruction of the limestone is more rapidly advanced by the innumerable punctures rather than by the perforation of the *Saxicava*; such is the competition for a location in the stone by these minute and numerous settlers, that not one in one hundred obtains an entrance.

“It is not at Plymouth only where these shell-fish are to be found. I found them in the limestone quays in the harbour of Dartmouth, although I am not aware of limestone forming any part of the shores of the Dart. I think, however that Berry Head will be found perforated by them, and that the great depth of water near it may be owing to their operations.

“Engineers employed in the erection of public works, such as quays, docks, basins, or breakwaters, intended to last for centuries, would do well to consider whether limestone of any kind should be employed in such structures below the ordinary level of low water at spring-tides.”



REPLIES BY MR. WALKER TO QUERIES PUT BY ADMIRAL SIR BYAM MARTIN,  
JUNE 10, 1844.

Replies by Mr.  
Walker to Queries  
put by Admiral  
Sir Byam Martin.

Bovisand, June 13, 1844.

1st. Has the *Roche stone* of Portland been employed on the breakwater or other construction at Plymouth, and do the animals, mentioned by Mr. Walker, attack it, as well as the fine grained Portland stone called "block"? Do they attack the cap-stone or hard upper beds of the Portland?—There is not any Portland stone in the Plymouth Breakwater. There is however much Portland stone about the Dockyard sea-walls, and also at the Barbican, and some has been used at the old Victualling-office Point. The large four ton blocks formerly used for mooring the buoys upon the shoals were of coarse stone from Portland. These stones comprise the fine grain in the walls; and also some of the coarsest kind. They have all been more or less perforated by the borers. I have not seen any specimens of the Portland cap-stone used in submarine works. I am, however, of opinion, that as these courses are of the same mineral character as the lower series, (containing lime, shells, &c.) this stone would be exposed to the ravages of the *Saxicava rugosa*.

*General Remark.*—I have observed that these animals delight to bore or nibble away the finest and most pure parts of the limestone. This is abundantly apparent in the limestone rocks, now it is dug into holes and crevices, and the protuberant parts left untouched, are found to be impurities, containing earths, quartz, &c.

2nd. Do they touch granite?—They neither touch granite gneiss, porphyry, nor any of those sandstones that contain iron, quartz, nor those rocks of the trap description. In this list the basalts and greywacke rocks should be included.

3rd. Do they touch the hard sandstones—Bramley Fall for example?—The elementary parts of a sand-stone may be either fine, microscopic, or *comminuted* shell, like some specimens from Malta or Portland, &c., or there may be coralines, sponges in it, agglutinated by lime in some form—such stones will be perforated.

If a sand-stone be formed of earthy or quartz particles, which the *pholas* can neither mechanically bore or chemically dissolve, it will not touch it.

If the sandstone have its particles bound together by *an oxide of iron*, as some of the red sandstones have, it is safe from the attacks of marine borers.

*Remark.*—All the marine boring animals form their cells within the stone, and as I said before, fish from the mouths of their holes. It is therefore surface and clear water they require most. It is remarkable that all our limestone cliffs and promontories are steep and have deep water close to them, provided the waves and tides keep them clean and clear of mud or sand, (for mud or sand kills them.) Portland has deep water everywhere seaward. The Berryhead is limestone, it is quite steep. The water over the limestone in Plymouth Sound and Hamoaze is much deeper than in the Sound, as for example, from the citadel along the north shore and round by Devil's Point to Hamoaze. Haulbowline Island in the Cove of Cork is limestone, the tide of ebb keeps its north side clean, and it is cut almost perpendicularly downwards with six or seven fathoms close to it.

I think that a breakwater might safely have a nucleus of limestone or Portland stone, provided that its crevices and cavities were filled up with solid matter in the shape of rubble, but in order that the structure should be permanent, the limestone should be covered with blocks of granite or other hard and heavy stones, with rubble of the same kind deposited so as to fill up all crevices and solidify the work—a practice which we now pursue here.

Your obedient servant,

WILLIAM WALKER.

Admiral Sir T. B. Martin, G.C.B.,

&c. &c. &c.



## APPENDIX B.

## LETTERS, &amp;c., ISSUED.

1. Sir Byam Martin to Captain Hornby, Comptroller-General of the Coast Guard, requesting that the officers of the Coast Guard may be directed to give any assistance required by the Commission.—*April 17, 1844.*
2. Sir Byam Martin to the Secretary of the Admiralty, requesting that Captain Bullock might be instructed to make a survey at Dungeness.—*May 3, 1844.*
3. Sir Byam Martin to the Commissioners of the Customs, requesting the officers belonging to that department might be directed to render any assistance required by the Commission.—*May 4, 1844.*
4. Sir Byam Martin to his Grace the Duke of Wellington, requesting that the officers of the Cinque Ports may be directed to give any assistance required by the Commission.—*May 4, 1844.*
5. Sir Byam Martin to General Sir George Murray, requesting that the officers of the Ordnance Department stationed at Dover, might be directed to assist the Commission in their inquiries.—*May 7, 1844.*
6. Sir Byam Martin to Captain Washington, R.N., directing him to proceed to Portsmouth.—*May 18, 1844.*
7. Sir Byam Martin to Captain Washington, directing him to assist in carrying out the survey of Portland by Captain Sheringham, if required.—*May 18, 1844.*
8. Sir Byam Martin to Lord Lincoln, requesting that the granting of a new lease of the Crown Quarries at Portland may be deferred.—*May 28, 1844.*
9. Sir Byam Martin to the Secretary of the Admiralty, notifying the satisfactory completion of the survey of Portland by Captain Sheringham.—*May 29, 1844.*
10. Sir Byam Martin to Captain Washington, directing him to proceed to Harwich.—*May 29, 1844.*
11. Sir Byam Martin to Lieutenant-Colonel Harry Jones, R.E., requesting his opinion on the proper section for the sea slope of breakwaters.—*June 1, 1844.*
12. The Secretary to James Walker, Esq., referring to the letter from the Admiralty of the 12th June, and requesting him to supply information upon the breakwater at Plymouth.—*June 13, 1844.*
13. The Secretary to J. Hussey, Esq., M.P., notifying that the paper respecting a harbour at Lyme Regis should be laid before the Commission.—*June 8, 1844.*
14. Sir Byam Martin to the Chairman of Lloyd's, requesting to know whether any of that body were desirous of giving the Commission their views on the subject of Harbours of Refuge.—*June 19, 1844.*
15. Sir Byam Martin to G. F. Young, Esq., Chairman of the Ship Owners' Society, requesting that he would afford the Commission any information he might see proper on the subject of their inquiries.—*July 14, 1844.*
16. Secretary to Captain Kerr, R.N., respecting borings to be made at the Chesil Bank.—*June 19, 1844.*
17. Sir Byam Martin to Captain Peat, R.N., respecting borings to be made at Dungeness.—*June 21, 1844.*
18. Secretary to Captain Peat, requesting that specimens of the water from Dover Bay may be sent for examination.—*July 5, 1844.*
19. Sir Byam Martin to Mr. Cubitt, requesting any further information respecting the deposits of silt in Folkstone Harbour.
20. Sir Byam Martin to the Harbour Master at Ramsgate, with inquiries as to the deposits of silt at that place.



## APPENDIX C.

### LIST OF PROJECTS, PAPERS, MODELS, &c., SUBMITTED TO THE HARBOUR COMMISSION.

- Captain Hood.—A project for the improvement of the tidal harbour of Newhaven and Cuckmere, by deepening the harbour, extending the piers, and forming Sleepers' Hole into a reservoir for a sluicing power.—See evidence.
- Mr. Stevens, Harbour Master, Newhaven.—To widen and deepen entrance of harbour—to widen also within the pier heads, and carry the piers out.—See evidence.
- Mr. Jessopps.—Project for Newhaven. To form Sleepers' Hole into a basin five acres in extent.
- Sir Henry Shiffner.—Project for Newhaven. Sleepers' Hole to be formed into a basin, with dry docks at either end; also a breakwater in Seaford Bay.
- Mr. Carey.—To excavate docks and basin at Newhaven.
- Mrs. Henry Ogle.—Proposing a breakwater in Eastbourne Bay, and docks or basins in the Crumble Lakes.
- General F. Maitland.—A basin to be formed in Romney Marsh, a mile square, with two entrances, one at Rye, and the other at Hythe.
- Captain Vetch.—The Goodwin Sands to be formed into an island, by encouraging, by certain artificial means, the deposit and retaining of the sand; also to redeem the Sandwich Flats.—See evidence.
- Mr. Bush.—The construction of a harbour, by sinking iron caissons on the substratum of the Goodwin Sands, enclosing the sands by a sea-wall 11 miles in extent, affording a harbour within of 2260 acres, with an average depth of six fathoms at low-water spring-tides.—See evidence.
- Mr. Mitchell.—To enclose and deepen a space for a harbour, by the sinking of cast-iron caissons on the Goodwin Sands, and concreting.
- General Ford, R.E., the late.—Report upon a project for a breakwater in Dover Bay.
- Mr. Steward.—Proposal for a breakwater in Dover Bay, detailed in his evidence.
- Mr. Jeffreys.—For the improvement of the entrance to Dover Harbour, by removing a bed of chalk on which he states that the shingle rests. Also for forming a harbour of refuge in Dover Bay.—See evidence.
- Proposition for a breakwater harbour in Dover Bay, by Captain Vetch, R.E.—See evidence.
- A Memorial from 456 Inhabitants of New Romney, Lydd, and the vicinity, respecting a harbour at Dungeness.
- Mr. Calver, R.N.—To form an internal harbour at Dungeness, with two entrances on a novel principle.
- Mr. Barrett.—An internal harbour at Dungeness.
- Mr. Johnstone.—An internal harbour at Dungeness.
- Mr. Potter.—Improvement of Rye Harbour, and the construction of a breakwater in the West Bay at Dungeness.
- Mr. Calver.—An inner harbour at Lowestoft Ness.
- Messrs. Lamb, Bush, and Harvey.—Projects for a breakwater at Portland (already published).
- Captain Taylor.—To cut through the Chesil Bank at Portland, and connect the two bays; also his proposition for "submarine breakwaters," and a floating breakwater outside as generally applicable.
- Mr. Calver, R.N.—To cut through the Chesil beach at Portland, and connect the bays.
- Rev. Thomas Kingdon.—A suggestion that a harbour of refuge be established on the south-west coast of Cornwall, about 10 miles from Lannceston; mentioning a point near Widemouth, named Melluck, for the position.
- Proposition for increasing and extending the harbour of Lyme Regis for the reception of large craft; forwarded by the Mayor.
- A Memorial of Shipowners and others, suggesting the improvement of the harbour and erection of a breakwater at Brixham—Torbay.
- Mr. Johnston.—Breakwater at Brighton, fully described in Report of Shipwreck Committee.
- Mr. Barrett on the subject of the Formation of Bars.—See evidence.



Mr. T. W. Tanner.—Essay on harbours, deposits, bars, &c.

Mr. Prichard on Bar Harbours.

Mr. Doull.—Proposition for a Lighthouse on the Goodwin Sands.

Mr. T. F. Cook.—Proposition for the Prevention of the accumulation of Shingle at Dover.

Mr. Newman.—A project for a Breakwater at Portland.

Mr. Fraser.—An Essay on Harbours and Bars.

Mr. White.—Proposition for a floating Breakwater.

Captain Sir Samuel Brown.—Model of a floating Breakwater formed of bronze bars, and packed with turf or cork, and rendered buoyant by cylinders combined with the structure.

Also a Model of a fixed Breakwater of bronze, capable of being floated to its place, or weighed again by attaching cylinders.

Captain Vetch, R. E.—Model of a project for a Pier constructed of upright iron rods, made solid with concrete, cased in brickwork above low-water level.

Also a Model of a Screen or Breakwater formed with vertical iron rods, supported in a frame of a triangular section, and proposed to be erected in crossing a tideway, where it is desirable not to interrupt the stream and scour.

Dr. Potts, M. D.—Model of an Hydraulic Machine, by means of which iron cylinders may be sunk in sand and breakwaters formed.—See evidence.

Mr. W. H. Smith.—A Model of a floating wooden Breakwater and its moorings.—See evidence.































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